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OF THE

DEPARTMENT OF AGRICULTURE

FOR THE

FISCAL YEAR ENDED JUNE 30, 1903.

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REPORT OF THE  
SECRETARY OF AGRICULTURE.  
DEPARTMENTAL REPORTS.

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REPORT  
OF THE  
SECRETARY OF AGRICULTURE.

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# REPORT

## OF THE

### SECRETARY OF AGRICULTURE.

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TO THE PRESIDENT:

I have the honor to submit herewith my Seventh Annual Report as Secretary of Agriculture.

#### EDUCATIONAL REQUIREMENTS OF AGRICULTURAL RESEARCH.

The research work of the Department of Agriculture covering the sciences of production in the fields and other laboratories where the crops of the country are grown and where they are made more valuable by skill, has required a class of experts not educated by the institutions of learning where our people have heretofore been prepared for their life work. The development of the Department toward doing all that should be done to help our people secure a greater yield from the soil and enhance the value of its products, made the training of experts in the Department a necessity.

The country needed scholars along all the lines of work considered in this report. The agricultural colleges of the States are the natural sources from which students for this work should be expected to come, and we have availed ourselves of all the competent graduates of these institutions that could be induced to take up advanced work with us; but the demand has been so great, and the growth of the Department so rapid, that we have been compelled to seek the most competent men wherever we could find them.

The theory of our duty is to help any locality that is struggling with a problem to an early solution of which the experience of our scientists may contribute or where the undertaking is beyond the means at the disposal of the people interested.

To these ends many specialists must be trained, and for these purposes the Department has become a post-graduate institution where groups of sciences are taught and applied. Comparatively little time is devoted to the ascertainment of abstract scientific facts. Every

worker is helping somebody, and while doing this he is contributing to what is known relating to the farm, and to the education of his associates.

Four hundred and ninety-six students have been admitted to the Department for instruction since 1897 as experts in our several lines of work. Two hundred and forty-nine of these still remain with us, not less than 132 having passed into the classified service; 185 have gone elsewhere to teach, experiment, or demonstrate in private enterprise what they have learned from their teachers, who are our best-equipped scientists in their several specialties.

The Department has been extending its work in all parts of the country during the past year wherever the producers from the soil most need help. Our most active efforts have been directed to the stamping out of foot-and-mouth disease in four of the New England States, and in studying the cotton boll-weevil in Texas and demonstrating the growing of cotton successfully in spite of the presence of the pest. Encouraging progress has been made in all the lines of research with which the Department is charged.

#### OUR SURPLUS PRODUCTION.

Out of their continued abundance, during the past year, the farmers of the nation have contributed food and raw materials for manufactures to hundreds of millions of people in foreign countries, besides sustaining 80,000,000 at home.

A survey of half a century discovers the remarkable character of the movement in which the farmers of this country have become the chief purveyors of the world.

In 1851 our shipments of farm products were valued at \$147,000,000, while half a century later, in 1901, they amounted to \$952,000,000, an increase of \$805,000,000, or about 550 per cent. The farmers' export trade for the decade 1851-1860 amounted to \$1,896,000,000, and in the following decade, in spite of the transfer of multitudes of men from productive to destructive life, the total was \$2,431,000,000. In the decade after that, the export trade doubled and amounted to \$4,864,000,000. In the next decade, the amount grew to \$5,740,000,000, and the total for the decade of 1891-1900 was \$7,032,000,000, or an average of over \$703,000,000 a year. Subsequent to the last-named period this trade has gone on increasing and reached its highest amount in 1901 with exports valued at \$952,000,000. The export trade in farm products for 1903 was valued at over \$878,000,000, an amount second only to that of 1901.

The consumption of cotton in this country is now greater than that of any other country, and yet the cotton planters of the South not only supplied this market last year, but exported a surplus of 3,569,000,000

pounds, valued at \$317,000,000, or for every working day in the year about 12,000,000 pounds, worth more than \$1,000,000.

Represented in value, the exports of grain and grain products had about two-thirds of the importance of cotton in the last fiscal year, the value of the export being more than \$221,000,000. From 46,000,000 acres of wheat there was a surplus for foreign mouths amounting to 114,000,000 bushels and 20,000,000 barrels of flour, amounts that together represent 204,000,000 bushels of wheat.

Third in importance are the exports of meats and meat products, with a grand total of \$178,000,000, to which may be added \$35,000,000 for live animals. Quantities that are beyond the grasp of the mind represent the exports of meats and their products. The pounds of beef were 385,000,000; of pork, 551,000,000; of lard, 491,000,000; and of oleo oil, 126,000,000.

The foregoing figures, it should be borne in mind, do not stand for the total production of the farms, but for the surplus production after the wants of the people at home have been satisfied.

#### THE FARMER'S BALANCE OF TRADE.

The immense exports from the farms of the country lead to an examination of the so-called balance of trade. This examination reveals what seems to have escaped the attention of the public, and that is, that the favorable balance of trade, everything included, is due to the still more favorable balance of trade in the products of the farm.

During the thirteen years 1890-1902 the average annual excess of domestic exports over imports amounted to \$275,000,000, and during the same time the annual average in favor of farm products was \$337,000,000, from which it is apparent that there was an average annual adverse balance of trade in products other than those of the farm amounting to \$62,000,000, which the farmers offset and had left \$275,000,000 to the credit of themselves and the country.

Taking the business of 1903, the comparison is much more favorable to the farmers than during the preceding thirteen-year period, since the value of domestic exports over imports was \$367,000,000, the entire trade being included, while the excess for farm products was \$422,000,000, which was sufficient not only to offset the unfavorable balance of trade of \$56,000,000 in products other than those of the farm, but to leave, as above stated, the enormous favorable balance of \$367,000,000.

During the last fourteen years there was a balance of trade in favor of farm products, without excepting any year, that amounted to \$4,806,000,000. Against this was an adverse balance of trade in products other than those of the farm of \$865,000,000, and the farmers not only canceled this immense obligation, but had enough left to

place \$3,940,000,000 to the credit of the nation when the books of international exchange were balanced.

These figures tersely express the immense national reserve-sustaining power of the farmers of the country under present quantities of production. It is the farmers who have paid the foreign bondholders.

### MAGNITUDE OF PRODUCTION.

The height to which farm production has risen to supply the demands of domestic and foreign consumption should not be overlooked. Taking the range of recent years, there is the product of wheat, 600,000,000 to 750,000,000 bushels, worth to the farmer from \$350,000,000 to \$450,000,000. On more than 90,000,000 acres grow 2,000,000,000 to 2,500,000,000 bushels of corn, with a value which ran up to more than \$1,000,000,000 on the farm in 1902.

The oat crop now reaches close to 1,000,000,000 bushels, with a value of \$300,000,000; the barley crop overruns 100,000,000 bushels, worth \$50,000,000, and the rice crop in 1902 amounted to 390,000,000 pounds.

One of the most valuable three of all farm crops is that of hay, aggregating about 50,000,000 to 60,000,000 tons, worth \$450,000,000 to \$550,000,000; ranging between 200,000,000 and 300,000,000 bushels is the potato crop.

The acreage of the cotton crop has displayed a tendency to increase considerably during the last few years, and in 1903 was about 29,000,000 acres; the number of bales produced in recent years ranges from 10,000,000 to 11,000,000, while the value of the entire crop on the plantations has gone as high as \$511,000,000 for the crop of 1900, or, if the seed is included, \$530,000,000.

Tobacco is another crop of expanding proportions, and the prospect now is that within a few years ten figures will be required to represent the annual production. This crop has now climbed close to 900,000,000 pounds, valued at \$60,000,000.

Only some of the principal farm products have been mentioned, but these are sufficient to indicate, in conjunction with information concerning the less important products, that the value of all farm products not fed to live stock for 1903 considerably exceeded their value in the census crop year 1899, when it was \$3,742,000,000.

### NATIONAL STOCK OF FARM ANIMALS.

The Department's inventory of farm animals January 1, 1903, discovers that while some classes of animals are only holding their large proportions, others are increasing. The horses number 16,557,000, with a value of \$1,031,000,000. The mules have increased to 2,728,000, with a value of nearly \$200,000,000.



Dairying shows marked expansion, and now depends upon 17,105,000 milch cows, with a value of \$517,000,000. Other cattle of all sorts number 45,000,000, with a value of \$824,000,000.

The number of sheep has had a tendency to decline at times during the last score of years, but within the last four years has increased decisively, so that now the sheep number 64,000,000, with a value of \$168,000,000.

Hogs have remained about stationary in number for many years, and in 1903 were found to be 47,000,000, with a value of \$365,000,000.

#### BETTER DISTRIBUTION OF PROGRESS.

There is one other particular feature of the farmers' improved and gratifying condition that should be noticed, and this seems to have escaped attention. During the long period of time when the new and productive land of the West was easily obtained, and when the number of farms and the amount of production there multiplied at an amazing rate, the farmers of the East and the South suffered under a severe competition and an impending overproduction, and agriculture in these sections, apart from cotton production, was outstripped in the agricultural expansion of the West. Since 1890, however, there has been a turn in the trend of this expansion; the northern half of the Mississippi Valley is not overshadowing the other sections of the country in its rate of expansion as formerly; an improvement in the welfare of farmers in other sections of the country, as well as in the North Central States, is in evidence. In other words, there is a more even distribution of expansion, progress, and welfare than before.

The South, which had been backward in its corn production for many years preceding 1890, finds itself since that time with its fraction of the national production of corn increasing faster than that of any other section; the same is true with regard to wheat, sweet potatoes, and cane and sorghum sirup; and to these may be added tobacco and farm-made butter, and horses, mules, and swine. The South occupies a second place in the rate of increase of production, in comparison with other sections, in buckwheat, hay, apple and peach trees, cattle other than milch cows, and farm-made cheese.

In a similar way, agriculture in the East is rehabilitating itself by gaining faster than in other sections of the country in the production of buckwheat and potatoes, while it stands second in order among the different sections in its increasing production of rye and of sweet potatoes, and in the number of milch cows.

The group of States embracing the Rocky Mountain and Pacific Coast region is showing a larger gain relatively than other sections in the production of rye, hay, apple trees, and farm cheese, and in the possession of sheep and milch cows; while it holds a secondary place in

relative advancement in the production of wheat, oats, barley, potatoes, and farm butter, and in the possession of horses, mules, and swine.

The North Central States have by no means lost for all products the foremost place in rapid rate of advancement that they have enjoyed for many years. Since 1890 this section has increased its production faster than other sections for oats, barley, flax, peach trees, and cattle other than milch cows; and this section does not stand second in rate of advancement in any of the products under consideration.

Thus, it appears that a new life has come to agriculture in all parts of the country, and that there are achievement, hope, and promise for the farmer everywhere.

The above review of our agricultural products and exports is presented not only in grateful acknowledgment of the bountiful Providence which has so generously filled our cup of prosperity, but also from a desire to present thus succinctly to the statesmen and to the men of affairs of this country the value and importance of this vast agricultural industry, supported by three-eighths of our working population, and contributing so greatly to the prosperity of the whole country. It is this vast constituency and still vaster industry that the Department of Agriculture is charged to protect, cherish, and encourage, and its extent can only be appreciated by those who are not brought continuously in direct contact with it, by the perusal and study of the foregoing figures and consideration of the important facts they present.

#### **WEATHER BUREAU.**

The Weather Bureau has, through its officials at the various stations throughout the country, taken an active part in public education along meteorological lines. In 12 colleges or universities during the past year Weather Bureau officials have conducted regular courses of lectures or classes of instruction in meteorology and climatology, and at 5 of these institutions the official is a member of the faculty. At 16 stations the officials have delivered occasional addresses outside of their offices to schools or colleges, and at 28 stations they have given frequent talks in their offices to pupils and teachers of schools. In 14 instances they have delivered occasional addresses outside of their offices to farmers' institutes and similar organizations. Only a few years ago there was very little instruction of this nature given in our colleges, universities, or public schools, but the demand for it has rapidly increased. The action of the Bureau in this direction will undoubtedly result in a wider knowledge and a more intelligent understanding of its work, and a consequent increase in its usefulness and value. Many of the young men who receive instruction in these classes are attracted to the service of the Bureau as an occupation, and the

Bureau profits by securing a class of employees with special training and equipment.

The year 1902-3 marks a distinct advance by the Weather Bureau in the science of meteorology, especially in two directions. From the beginning of the weather forecasts by the Government, in 1871, the necessary observations at the several stations have always been reduced to the sea-level plane. It was conceived some years ago that the numerous defects in forecasting might be diminished, and the uncertainty as to the true cause of storms removed, if similar daily charts were also constructed at higher levels, for which purpose the 3,500-foot and the 10,000-foot planes were selected. After much laborious computation, as shown in the barometry report of 1900-1901, the necessary reductions were made, and we now possess daily weather charts on the three planes mentioned. The study of these supplementary maps is going on, with encouraging prospects of more reliable forecasts of the weather conditions, and it is hoped by January 1, 1904, to make them a part of the regular daily work of the forecasting service. At present the improved data are confined to the barometric pressures, but it is most important to secure charts of the temperature on the two upper planes as well. Unfortunately, we have no observations of temperature in the higher atmosphere suitable for this purpose, and they can be secured only by means of numerous balloon and kite ascensions carrying the necessary self-registering instruments.

It has been thought proper for many reasons to establish on the Blue Ridge Mountains, at Mount Weather, Bluemont, Va., a modern meteorological observatory of the best class for scientific research pertaining to problems of weather phenomena. A building for administration and for a school of instruction is being erected, and the plans are well advanced for a suitable power house and shop for balloon and kite ascensions, which will be built during the coming year. The recent advances in solar and terrestrial meteorology justify us in preparing to study at first hand the variations in the solar activity, and the corresponding changes in the weather conditions, especially from season to season. It is a complex problem and will require the best instrumental equipment, the ablest students, and a long series of observations before it can be finally solved. The desirability of being able to foresee a year in advance the type of season probable during a given period is so great as to make it imperative to lay broad scientific foundations at the beginning of the twentieth century, which will be of utility for future generations, who will surely build a great science of cosmical meteorology upon such data as can be supplied by the Mount Weather Observatory.

#### SUBMARINE CABLES.

New submarine cables in connection with the vessel-reporting and storm-warning services have been laid from Sand Key to Key West.



Fla.; from Southeast Farallone to Point Reyes, Cal.; from Block Island to Narragansett Pier, R. I.; and from Glen Haven to South Manitou Island, Mich., a total of about 50 miles. Additional vessel-reporting stations have been established at Sand Key, Fla., and Southeast Farallone, Cal.

To meet the demands of the maritime and commercial interests of the Pacific coast a cable has been laid to connect San Francisco and the Farallone Islands, with a weather observatory and vessel-reporting station on the South Farallone Island. A wireless station has also been installed there to insure communication in future should the cable be out of order.

#### RIVER AND FLOOD SERVICE.

The work of the river and flood service, owing to the numerous and disastrous floods that occurred, has been a prominent feature of the year. Several of the floods were the greatest of which there is authentic record, and were remarkable both for their wide extent and for their destructive character. Our warnings were prompt and timely, and in the main remarkably accurate; and in no instance was the coming of a dangerous flood unheralded. The forecasts of the great floods of March, April, and June, 1903, afford noteworthy examples of the efficiency of this service. This should be extended to the Kansas and other rivers, where no stations have yet been established.

#### DISTRIBUTION OF FORECASTS AND SPECIAL WARNINGS.

Inadequate appropriations have prevented any extensions in the important work of distributing forecasts and special warnings, and of necessity our efforts have been confined to maintaining the service already in operation, with its various ramifications, and adopting such suggested improvements as might be effected without additional expense.

A marked increase (nearly 20,000) is shown in the number of places receiving forecasts by telephone without expense to the Government of the United States, and with the rapid extension of "farmers' telephone lines" opportunity is afforded for placing weather information directly in the homes of the more progressive agriculturists, as well as in the telephone exchanges of rural centers of population, where it is posted for the general information of the public.

#### NATIONAL CLIMATE AND CROP BULLETIN.

The National Climate and Crop Bulletin has been issued in the usual form, with charts showing the current temperature and precipitation, extremes of temperatures, and the departures from the normal of both temperature and precipitation. In this bulletin the current mete-

orological conditions are discussed in their relation to crop growth from the beginning to the end of the crop season.

#### BUILDINGS ERECTED AND PROPOSED.

During the past fiscal year, through the appropriations by Congress, it has been possible to erect buildings for use as meteorological observatories for the Weather Bureau at the following-named places, and at a total cost of \$32,922.97, viz: Amarillo, Tex.; Modena, Utah; Key West, Fla.; Sand Key, Fla.; Southeast Farallone, Cal.; and buildings are now in course of erection at the following places, the total cost of which will be \$70,900, viz: Yellowstone Park, Wyo.; Duluth, Minn.; Devils Lake, N. Dak.; Havre, Mont.; Mount Weather, Va.; Block Island, R. I.; Narragansett Pier, R. I.

The wisdom of erecting buildings for the exclusive use and under the control of the Weather Bureau becomes more apparent every day. It saves to the Government the amount heretofore paid for rent of office quarters, which in many cases are unsuited to our needs, especially as regards the architecture of the roofs for the exposure of meteorological instruments.

#### BUREAU OF ANIMAL INDUSTRY.

A marked distinction between our country and all others is the more generous nutrition of our people. Our domestic animals contribute to this result, and furnish a large percentage of our exports. This has been brought about by abundance of comparatively cheap grass and grain rather than through superior knowledge of breeding and feeding. We have developed a track horse, a lard hog, and but little else.

The Bureau of Animal Industry has given standing in interstate and foreign commerce to our animals and their products, and is battling successfully with diseases and disabilities originating at home and abroad. It is considering the wisdom of undertaking systematic cooperation with the State experiment stations in the production of types of animals suited to our varying latitudes and conditions, in order that more economy may be observed in production.

#### CONTAGIOUS DISEASES OF ANIMALS.

The control of the contagious and infectious diseases of animals is one of the most important lines of work in which the Department is engaged, and this work must become more valuable and of greater necessity as the number of animals in the country increases and as traffic with countries in which such diseases exist is further developed.



## FOOT-AND-MOUTH DISEASE.

Last year, for the first time in eighteen years, foot-and-mouth disease was discovered in the United States. The manner in which the contagion was brought in is not definitely known, but it evidently came with some articles of merchandise, as it first appeared near the docks of the port of Boston, and spread from there toward the interior. When the existence of this disease was recognized and brought to the attention of the Department the contagion had already spread over the eastern part of the State of Massachusetts and into the States of Rhode Island, New Hampshire, and Vermont. The whole country was menaced with the plague, and it was only by the adoption of radical measures and by the prompt, efficient, and indefatigable work of the inspectors that the contagion was controlled and eradicated.

The plan of work was, briefly, to rigidly quarantine all infected premises and the animals upon them, to slaughter at the earliest practicable moment all susceptible animals on such premises, and to disinfect the stables, pens, and utensils in a thorough manner. Operations were begun December 1, 1902, and the last diseased herd in this outbreak was slaughtered May 9, 1903. The cooperation of the executive departments of the several affected States was prompt and complete, and enabled the Federal authorities to enforce regulations and stamp out the disease wherever it was found. The number of animals slaughtered on account of this disease was 4,461, of which 3,872 were cattle, 360 hogs, and 229 sheep and goats. There was allowed by this Department 70 per cent of the appraised valuation as indemnity. The total amount thus paid was \$128,908.57. There were other expenses, such as for salaries, traveling, labor, disinfectants, etc., which were additional to this amount, but the total cost of the eradication of the disease was less than \$300,000.

The stock raisers of the country were saved from a great calamity by the successful termination of this work. It is the general history of the disease in other countries that where an outbreak assumes the proportions of the one which existed in New England last winter it spreads over the whole country, affecting sooner or later practically all of the cattle and a large part of the sheep and hogs. As the value of grown cattle shrinks from 20 to 30 per cent in consequence of the disease, as some of these die, together with a considerable proportion of the young animals, and as hogs and sheep are also seriously affected, it is plain that the direct losses from a general extension of the contagion over the country would be some hundreds of millions of dollars, while the indirect losses from domestic quarantines and restrictions on traffic and from embargoes on our export trade would be simply incalculable. These losses were avoided, because the Department had a force of competent and trained veterinarians who were at once taken

from their duties in other parts of the country and concentrated in the infected section, and who loyally and cheerfully endured the hardships of a winter campaign in the rural districts, where the cold much of the time was extreme, the roads blocked with snow, and the difficulties connected with the disposal of the carcasses of slaughtered animals and the disinfection of the premises were almost insurmountable.

#### SHEEP SCAB.

Energetic work has been carried on during the year with the object of controlling as effectually as possible the contagious disease of sheep known as scabies, or scab. Heretofore but little has been done for the repression of this disease except in the channels of interstate commerce, and it was hoped that the prohibition of the shipment of diseased sheep would be sufficient to cause the owners of such animals to treat them on the farms and ranges, and thus eradicate the contagion. While this result followed in some cases, it is unfortunately true that the greater part of the owners of this class of animals have neglected to take proper measures and have apparently relied upon their ability to elude or deceive the inspectors and run their animals through to market without the actual condition being discovered. The attempts to accomplish this have kept the stock cars and stock pens used for animals in interstate commerce so thoroughly infected that satisfactory progress with the disease could not be made. It was therefore determined to cooperate with some of the worst infected States, and attack the contagion at its origin by stamping it out on the premises where it exists and propagates from year to year. This has required somewhat of an increase of the field-inspection force, but it is apparently only in this way that the disease can be controlled.

The inspectors have inspected in this work during the year an aggregate of 16,444,370 head of sheep, and have supervised the dipping of 2,167,002 sheep, of which 394,636 were dipped twice. This enormous amount of work has had great influence for good, and if continued for a few years, will free the sheep industry from this incubus, which has for many years been the source of great discouragement and loss.

#### TEXAS FEVER.

The inspection and supervision of cattle in transit from the Texas-fever district has also involved a great amount of work. These animals are capable of spreading contagion through the ticks with which they are infested, and must, therefore, be kept in different cars and yards and driven over different roads from those used for other cattle. It is moreover necessary to inspect many cattle from the district adjacent to the infected section in order to determine definitely that they have not been exposed, and that they may safely be allowed to go forward to market through the channels of interstate commerce

without danger to the animals of any other section of the country. This service required the inspection of 1,620,403 cattle from the infected district, and of 389,525 cattle from the adjacent district. To guard against the spread of the contagion by infected cars, 66,116 of these were cleaned and disinfected by the direction and under the supervision of the inspectors.

It is well known that if Southern cattle are entirely freed from that species of ticks known as the *Boophilus annulatus* they can be allowed to mingle with the most susceptible animals without danger. Many efforts have been made to discover a practicable method for destroying this parasite without injuring the cattle, and the Bureau of Animal Industry has experimented for years with this object in view. Such treatment, if successful, would relieve most of the Southern cattle from quarantine restrictions, and would make these cattle bring more money in the markets of the country. After many failures, apparent success has been reached by dipping the cattle in the crude oil obtained from certain Texas wells. This oil is heavily charged with sulphur, and in the experiments so far made has not materially affected the cattle. It is necessary to regard such a treatment with some reserve until a large number of animals have been treated under the conditions which obtain in the practical shipment of cattle from the infected district to the markets; but it may be said now that this oil has been tried at the animal industry experiment station near Washington with entirely successful results, being distinctly superior to any other substance tested, and that it has also been tried in the field with about 70 head of cattle, the effect being equally favorable. Arrangements are now made for using the treatment on a much larger number of animals, and if, as hoped, no objections to it develop, it will be of inestimable value to the cattle industry of the Southern States.

#### HOG CHOLERA.

The losses from contagious disease among hogs in the United States have been enormous, probably reaching in some years the aggregate of \$75,000,000, and being seldom less than \$30,000,000. This Department has for a quarter of a century been conducting scientific experiments with a view to elucidating the nature of the disease and developing some practical treatment by which it might be controlled; and while much has been discovered as to the effects of certain bacilli, and as to the desirability of sanitary measures, no satisfactory method of controlling the disease has been evolved. Recently it has been shown by the Bureau of Animal Industry that there is, at least in some of the outbreaks, a different cause at work from what has heretofore been suspected. When the bacilli which have been supposed to cause the disease are all filtered from the blood, this liquid is still capable of producing the malady and has apparently the same degree of virulence



as it had before filtering. It is yet too early to estimate the proportion of the losses attributed to hog cholera which are caused by this agent, which passes through the finest filters, and which in this condition must be too small to be revealed by the highest powers of the microscope. Investigations are now being made to throw some light upon this question; but enough is already known to make it probable that this discovery will prove of very great importance.

#### TUBERCULOSIS.

Investigations have been conducted with human and animal tuberculosis, with a view of determining whether the disease is transmissible from man to animals or from animals to man. It has been shown by the experiments which have been made that there are cases of human tuberculosis in which the bacilli are as virulent for cattle as are the bacilli obtained from animals affected with the disease. The conclusion from this fact is that either human and animal tuberculosis are identical and intercommunicable or the persons from whom these virulent bacilli were obtained had been infected with bovine tuberculosis. In either case, it must hereafter be admitted that the tuberculosis of animals is a menace to human health, and that both for economical and for sanitary reasons measures should be adopted for its control

#### BLACKLEG.

The work against blackleg continues satisfactory. During the season the Bureau vaccine was used with 775,877 cattle, and the percentage of deaths after vaccination, not counting those animals that were evidently diseased before vaccination, was 0.53; whereas before vaccination the average percentage of losses among the same herds was 2.69.

#### INSPECTION OF ANIMALS AND ANIMAL PRODUCTS.

The number of certificates of inspection issued for American cattle exported to Europe was 960. The number of clearances of vessels carrying live stock was 634. The number of sheep inspected for export to Europe decreased from 211,224 in 1902 to 111,448 this year. The exports of horses fell off very considerably also, being 3,910 this year, as against 10,967 in 1902. Of the 228,365 cattle inspected for export, 226,613 went to Great Britain.

#### MEAT INSPECTION.

In the meat-inspection service the number of ante-mortem inspections was as follows: Cattle, 11,988,760; sheep, 14,654,249; calves, 1,041,138; hogs, 31,546,222; horses, 344; a total of all animals of 59,230,713. The following post-mortem inspections were also made: Cattle, 6,165,890; sheep, 8,598,175; calves, 670,173; hogs, 21,827,047; horses, 344—a total of 37,261,629.

The meat-inspection tag or label was placed upon 21,124,318 quarters, 362,689 pieces, and 186 sacks of beef; 8,571,643 carcasses of sheep; 667,259 carcasses of calves; 880,945 carcasses of hogs, and 696,279 sacks of pork.

The meat-inspection stamp was affixed to packages of meat products that had received the ordinary inspection, as follows: 7,520,854 of beef, 59,314 of mutton, 14,601,202 of pork, and 70 of horseflesh—a total of 22,181,440.

The number of cars sealed containing inspected meat products for shipment from official abattoirs and other places was 67,046.

The number of certificates of ordinary inspection issued for meat products for export, exclusive of horseflesh, was 30,152. Of beef, there were 1,388,633 quarters, 20,422 pieces, 401 bags, and 1,352,291 packages, with a weight of 371,920,737 pounds; of mutton, there were 35,394 carcasses and 22,527 packages, weighing 2,729,013 pounds; of pork, there were 24,380 carcasses and 506,311 packages, weighing 133,122,610 pounds.

The decrease in the certified exports of beef and pork, noted in the last report, continued, the figures showing a decline from the last year of 45,070,025 pounds of beef, and 55,237,401 pounds of pork. The exports of mutton were nearly two and a half times as much as last year, when there were 1,145,248 pounds certified.

There was one shipment of horseflesh, 70 packages, weighing 28,000 pounds.

The cost of the work of the ordinary meat inspection for the year was \$711,546.18.

#### MICROSCOPICALLY INSPECTED PORK.

The exports of microscopically inspected pork to countries requiring inspection decreased 14,572,888 pounds—from 33,681,229 in 1902 to 19,108,341 in 1903. The cost of the microscopic inspection was \$78,179.63, being an average of 16 cents for each examination, and for each pound exported 0.41 cent.

#### IMPORTS FROM MEXICO.

There were imported from Mexico 52,780 cattle, 4,119 sheep, 1,794 goats, and small numbers of other animals. At seacoast ports there were imported 2,602 horses and 169 ponies.

#### RENOVATED-BUTTER INSPECTION.

The inspection of dairy products under the act of March 2, 1902, was continued. Repeated inspections were made of 82 renovated-butter factories, located in 17 States, and the quantity of butter made by these was 54,656,800 pounds. This was an increase of 9 per cent over the previous year.



**BUREAU OF PLANT INDUSTRY.**

The work of the Bureau of Plant Industry has been pushed with vigor during the year. The advances made and the suggestions and recommendations for future work are set forth under the accompanying headings, and are believed, in all cases, to be for the betterment of agricultural conditions in the United States.

**COOPERATION WITH THE EXPERIMENT STATIONS.**

The Bureau is cooperating now with more than forty State experiment stations along many varied lines. The improvement of forage crop conditions, the extension of the work on cereals, the testing of new seeds and plants from home and abroad, demonstration work in the treatment of plant diseases, etc., are some of the more important problems upon which the stations are contributing to the Bureau.

**THE DISTRIBUTION OF SEEDS AND PLANTS.**

As set forth in my last report, a number of changes have been made in the securing and distributing of seed for Congressional purposes. Instead of contracting for all the seed and having it put up by one firm, the Department has purchased the seed and arranged for the putting of it up by contract. This is a great improvement over the old method, as it practically removes all opportunities for difficulties which have been encountered in the past in the matter of substituting inferior seeds for those called for, giving short weights, etc. With the enormous amount of seed that has to be purchased in the Congressional distribution, it is impossible to make provision in advance for everything that will be required. If seed were a fixed commodity it would not be difficult to make specific contracts for the delivery of particular quantities at particular times. So much, however, depends upon weather and other conditions that it can never be determined until the harvests are all over as to what seed can and what can not be obtained. For this reason it is not practicable, nor is it desirable, that the Department should endeavor to secure its seed by the ordinary contract system. Inferior seed can so easily be substituted for good that the Department must devote special attention to this phase of the subject in order that nothing but the best may go out.

To accomplish this, seed, for the most part, must be purchased in the open market from men who are known to be reliable and in whom dependence can be placed for furnishing seed according to contract. To protect the Department in all of its interests, inspectors are kept constantly in the field during the growing season looking after the crops that are being grown for the Department and in other ways keeping track of the seed conditions in general, so as to be intelligently guided

in the matter of purchases. Furthermore, the Department, by judicious placing of orders for seed, can encourage home industries. This it is endeavoring to do in every case where it is practicable. In a number of instances, where certain kinds of seed are grown to a large extent abroad, the Department has placed its orders with American growers in order to encourage the work in this country. This is particularly the case with flower seed, of which a number of kinds are now being specially grown for the Department on the Pacific coast and elsewhere.

Carrying out the plan as set forth in my last report, special attention has been given to particular crops, such as cotton, forage plants, and other crops. In the matter of cottons an effort has been made to secure for general distribution varieties which have come to the attention of the Department's officers as valuable sorts, but of local distribution only. The work in this connection has been exceedingly valuable, and many reports have been received as to the greater usefulness of the varieties distributed over those locally grown. The same is true of a large number of forage crops. A particular effort has been made in the matter of distributing home-grown sugar-beet seed. It has been found that sugar-beet seed can be grown successfully in this country, and that the beets from such seed yield a high sugar content. Ten thousand pounds of such seed were distributed last year, and careful work was inaugurated to determine the value of the product from these seeds as compared with seed grown abroad.

With regard to the securing and distributing of miscellaneous garden and flower seed, the fact remains that this work does not accomplish the ends for which the law was originally framed. There are collected, put up, and distributed now, on Congressional orders, nearly 40,000,000 packets of miscellaneous vegetable and flower seeds each year. These seeds are the best that can be obtained in the market, but from the fact that large numbers of packets are wanted, the seed obtained can be of standard sorts only, such as are to be found everywhere for sale in the open market. As there is no practical object to be gained in distributing this kind of seed, it seems very desirable that some change be made. To this end, it would seem wise to limit our work entirely to the securing and distributing of seeds, plants, etc., of new and rare sorts. There is still much to be done in the way of securing seeds, plants, etc., of this kind from abroad, but still more to be accomplished in careful investigations of our own possibilities in this direction. There are many valuable plants scattered all over this country which are still little known outside of their respective localities. These should be collected, tested, and distributed. There are also great possibilities of improving agricultural industries by distributing specially bred seeds and plants.

As the plant-breeding work of the Department increases, opportu-

nities for securing seed of this nature will accumulate. To do this work in the most effective manner, arrangements could be made in all cases to secure the advice and assistance of Senators and Representatives who have agricultural constituents. The Department has a well organized force of scientists who are thoroughly familiar with the general conditions of soil and climate in nearly all parts of the country. Special crops could be selected for special purposes, and with the advice and cooperation of Members of Congress such crops could be placed where they would do the most good. This is a line of work that would result in very much more value to individual districts throughout the country than the distribution of a large quantity of common varieties of garden seed, which have no particular merits so far as newness or promise are concerned. I shall inaugurate the coming year work along the lines here mentioned, and hope to receive the cooperation and aid of Congress in this matter.

#### NEW SEEDS AND PLANTS FROM ABROAD.

During the past year the seeds secured by our agents in Asia and Africa, to whose explorations reference was made in my last report, have been received and distributed. Special attention was paid this year to the reorganization of the work within the United States. It was felt that the time had come for more thorough work within this country, since there were many introductions that had not been pushed as they deserved to be. The clerical force was therefore strengthened, and a systematic attempt was made to secure reports from persons who had received seeds and plants. Many of these reports are now on file, and the work of compiling them to make them useful in further work is going on.

#### GRAINS.

Special attention has been given the grains. New wheats for the Northwest, new oats, new millets, and other crops have been pushed. The work on durum or macaroni wheats has been highly successful. Probably 10,000,000 bushels of this class of wheat were harvested in the crop of 1903. The value of macaroni wheats in the drier portions of the Great Plains is now fully established, and the demand for them is increasing as their value becomes better known. The quality of the wheats is always better in the drier areas, and in general they are not adapted to the ordinary spring and winter wheat districts. Where there is sufficient rainfall for good crops of spring and winter wheats, macaroni wheat should not be grown; especially as it is likely to be inferior in quality to such wheat grown in the drier regions, and could not, under such conditions, bring a price equal to that of the ordinary grades of spring and winter wheats or the better grades of macaroni



wheat. There is a constant foreign market sufficient for a good export trade, as soon as the business can be facilitated by opening up the proper trade channels, but the home demand at the local mills is most important and is rapidly increasing. At least 20 mills are now handling this wheat, and there may be others not yet known to this Department. At an average capacity, these mills, running half time on macaroni wheat, would consume between 3,000,000 and 4,000,000 bushels during the year. A large part of the product is in the form of semolina, which is now being used by eight to ten of the most important macaroni factories in the country, all of which had formerly used ordinary bread flour, and a number of which will hereafter use only the semolina from macaroni wheat.

Tests have been made during the year, first by private institutions and some of the experiment stations, and then by the Department, to determine the value of macaroni wheat flour for bread. The results appear to show that a very good quality of bread can be made from such flour. After a number of preliminary experiments by the Department a test was finally made in which 200 loaves, made from macaroni wheat flour, were compared with an equal number made from the highest grade of spring wheat patent. Selected experts among the millers, bakers, flour inspectors, grain dealers, and teachers of domestic economy throughout the country stated their opinions in writing as to the relative merits of the two breads. A consensus of these opinions showed that in this experiment, at least, the macaroni flour made a fine quality of bread.

#### ALFALFA.

The Turkestan alfalfa seed secured by our agent in Asia was distributed through the active cooperation of Members of Congress. This distribution was made in such a way that it would result in a supply of home-grown seed being available in the future, so that we may avoid the expense and uncertainty attending the importation of the seed. Reports received up to date indicate that many of the plantings made have been successful, and there is reason to hope that this valuable variety has been permanently introduced into the United States.

Of especial importance will be the introduction of an alfalfa adapted to the alkali parts of our arid Southwest. Work on this problem has been pushed forward during the year. The seed secured by our explorer in Algeria, as well as some sent by our representative from Turkestan, has been planted under the personal supervision of the Department experts. There is reason to believe that this introduction will be successful, in which case it will be possible to reclaim large areas of land in the Southwest that are now too alkaline for alfalfa.

## RICE.

The rice work done during the past year demonstrated the very important fact that by the use of proper varieties it is possible to materially extend the period of harvest. This has all along been one of the serious difficulties which the growers have had to encounter, but by the use of varieties which the Department has introduced it will be practicable to sow large tracts and to harvest as the different varieties ripen, without haste and without loss.

## FLAX.

The cultivation of flax is one of the oldest agricultural industries in the United States, but it has been forced to move steadily westward to new lands, as it became unprofitable in the older States. It was thought that flax exhausted the soil and could thus only be grown for a few years in one locality, but recent research has shown that the real cause of "flax-sick" land is a disease, the germ of which, living over in the soil, soon makes it impossible to produce flax where this disease is prevalent. The importance of the industry to our North-western States may be judged when it is known that in 1901 the State of North Dakota alone produced \$19,460,000 worth of flaxseed. To this must be added the growing industry of using the fiber of the seed flax for making binder twine and other coarse materials. This industry is seriously threatened by the same disease that has forced flax culture to move out of the Eastern States, and the Department has sent an expert to Europe in the hope that in some of the provinces of Russia a variety resistant to this disease might be found. In any event, it will be possible to secure better varieties than we now have and to learn how the farmers of Europe have managed to hold this disease in check.

## NEW LINES OF WORK IN SEED AND PLANT INTRODUCTION.

Among several new introductions designed especially to meet the needs of the Southeast have been improved varieties of cassava, which gives promise of great value for stock-feeding purposes and starch making; superior varieties of mango for cultivation in the extreme South, and Mexican peaches and apricots which, it is thought, will be better adapted to cultivation in the South than the varieties we now have. A number of plants of a choice variety of pineapple were also received from South Africa through the generosity of Hon. Barbour Lathrop.

Work has also been begun on the establishment of the matting industry in the United States. At present matting to the value of nearly \$5,000,000 is annually imported. A loom has been perfected for weaving the material, and the Department has undertaken the establishing of the cultivation of the raw material.



The Department annually receives many hundreds of packages of seeds and plants from abroad. These are all being carefully tested, and as fast as any give promise of value they will be propagated for further distribution.

The lines of work here enumerated are capable of great extension, and will result, as experience has already shown, in building up new industries of great importance to the country.

#### DRY-LAND AGRICULTURE.

Nearly one-third of the area of the United States has insufficient rainfall for the best culture of the ordinary crop plants. Considerable tracts of land are already irrigated and much more will be artificially watered in the future; but there must eventually remain enormous areas—doubtless nearly a fourth of the entire land surface of this country—which are doomed to remain perpetually in their present arid or semiarid condition for the want of an adequate supply of water for irrigation. The total rainfall over the lands lying between the one hundredth and one hundred and twentieth principal meridians is inadequate to irrigate more than a small fraction of the arable lands, no matter how carefully conserved and used. Dry farming is then a necessity, in order to utilize such lands where irrigation can never be practiced.

The Bureau of Plant Industry is occupying itself with the future of these regions, and is making a thorough study of the conditions and of the best ways and means of meeting them.

It is believed that not only can the grazing capacity of such lands be increased by intelligent management, but that large areas of such dry, but often extremely fertile, lands can ultimately be utilized for "dry farming." It is believed that as the irrigable lands become more and more completely occupied, there will be an increasing appreciation of the value of, and a greater effort to utilize, the dry, unirrigable lands adjoining settlements founded in the irrigated regions. In the meantime the scientists of this Department are endeavoring to secure plants that will grow in very dry soils, and at the same time yield paying crops that can be absorbed by our markets or profitably utilized on the farm. In order to carry out such introduction of new crops it is necessary to study most carefully the life history of each particular plant, in order to determine with some degree of accuracy its needs as to climate and soil, also its cultural requirements and the best methods of marketing or otherwise utilizing its products. It is only by carrying out in advance a life-history investigation in the most scientific way that it will be possible to introduce such new crops into profitable culture on a commercial scale without running the risk of most costly and discouraging failures.

To extend this important work a small increase in the appropriations has been included in the estimates of this Bureau.

#### NITROGEN-FIXING BACTERIA.

The fact that leguminous crops, like peas and clover, can obtain nitrogen directly from the atmosphere when certain bacteria are present on the roots has been known for a long time, and many attempts have been made to cultivate and use these bacteria in agricultural practice. Attention has been called in past reports to the progress the Department has made in investigating this problem. At the time of the last report the reason for the failure of former work from a practical standpoint, both in America and in Europe, had been determined, and a new, simple, cheap, and thoroughly satisfactory method of cultivating, distributing, and using these nitrogen-gathering organisms for all important crops had been perfected. During the past season the value of these bacteria has been demonstrated in extensive field tests. Good stands of clover and alfalfa, vetch, cow-peas, etc., have been secured in soils where, without the bacteria, these crops were a failure. The field work also demonstrated that soil and seed inoculation are equally valuable, so that either method may be used according to convenience. As a result of these experiments the Department is now prepared to furnish, in reasonable quantity, organisms for all the principal leguminous crops. Patents have been applied for, covering all the processes used, in order to make them secure for general public use. In order to enlarge the scope of this work and to carry on the necessary field demonstrations, an increase in the funds of the plant physiological and pathological investigations has been included in the estimates.

#### WATER CONTAMINATION BY ALGÆ.

It is well known that algæ of various kinds play an important part in the contamination of water supplies. The bad odors and tastes which some varieties of these plants give to water make it unpalatable to stock as well as to man. Some of the algæ also smother out aquatic crops, like cress, and furnish breeding places and food for mosquitoes. The physiologists of the Bureau of Plant Industry have now developed a cheap and effective method of exterminating algæ, which promises to be of universal application, in reservoirs, lakes, ponds, etc., where algal pollution exists. Extensive tests are now being carried out in cooperation with various board of health and water engineers, and the results so far have been extremely satisfactory. When the tests have been completed a full report will be issued and the method fully disclosed.

## NEW LONG-STAPLE UPLAND COTTON.

Attention was called in the last report to the fact that the plant-breeding experts had secured some hybrid long-staple Upland cottons which promised to be of great value. These are of the ideal type desired, having large bolls, very productive, with long, fine fiber, about  $1\frac{1}{4}$  and  $1\frac{3}{4}$  inches, borne on smooth black seeds. Preliminary field tests of the varieties have now been completed, and several of the best appear to be already fixed in type and come true by seed. Extensive field tests are under way, and if the results of the present season's work are satisfactory seed will be grown for distribution. Much attention has also been given to the improvement of the ordinary Upland types of cotton by straight selection. Many growers have become interested in this work, and appreciate the value and importance of careful selection of seed.

## EGYPTIAN COTTON.

Another important line of work which is receiving considerable attention at the hands of the Physiologist and Pathologist is the introduction and establishment of the best varieties of Egyptian cotton. We now import annually about \$7,500,000 worth of these cottons, and the demand is rapidly increasing. When first introduced, most of these varieties gave comparatively light yields, and in some cases the fiber apparently lost some of its essential characteristics. These difficulties, however, are gradually being overcome as the result of careful selection and breeding. Samples of fiber grown last year in experiment patches have been submitted to experts in this country and Europe, and several of them have been pronounced equal to the best Egyptian. Manufacturing tests are now in progress. The indications at the present stage of experiments favor the belief that we shall soon have varieties adapted to cultivation in this country. The tests are in progress in Georgia, South Carolina, Mississippi, Texas, New Mexico, Arizona, and southern California.

## DISEASE-RESISTANT COTTONS.

Great interest has been manifested by planters and handlers of cotton in our work of securing disease-resistant strains or varieties. The wilt-resistant Sea-island varieties distributed by the Department last year and this year have proved highly satisfactory. Wilt-resistant Upland strains have now been developed and are being grown on a large scale this season for the production of seed. Growers in all parts of the cotton belt where wilt occurs have adopted the method of resistant-seed selection recommended by the Department. In infected land the ordinary sorts are a complete failure, while the resistant varieties produce a good crop. Considerable progress has also been made in

selecting varieties resistant to Texas root rot, the boll-weevil, and other serious pests.

#### DISEASES OF SUGAR BEETS.

The work on sugar-beet diseases was continued during the year. The spraying experiments with Bordeaux mixture for the control of leaf blight were entirely satisfactory in holding the diseases in check, and resulted in an increase of approximately 50 per cent in the tonnage. Further investigations were also made of the disease known as curly top, which was prevalent last year and has been even more serious the present season. So far we have been unable to determine the cause of this malady, but there is hope of securing strains resistant to the disease. A small increase in the appropriations for this work has been put in my estimates.

#### DISEASES OF ORCHARD FRUITS.

The work on diseases of orchard fruits for the past year has been largely in the nature of demonstrative experiments, the idea being to show the practical growers how to put into operation the various methods of fighting disease. Especial attention has been given to little peach in Michigan and New York. In the former State, in cooperation with the State authorities, the disease has been stamped out of a large area. The principal work in pear blight has been carried on in Georgia. In the north Georgia experiments the treatment was entirely successful, the disease being eradicated from the experimental orchards. In the south Georgia experiments, while the disease was not completely eradicated, the treatment greatly improved the condition of the orchards as compared with the surrounding untreated orchards. From the large field experiments in the past two years the Department now feels certain that bacterial blight of pears and apples can be controlled if the treatment recommended by the Department is carried out thoroughly. Similar demonstrative work will be done in some other pear or apple section the coming season.

#### DISEASES OF TRUCK CROPS.

The intensive culture of vegetables for home and foreign markets has developed to great proportions in the United States. Wherever crops are grown on an extensive scale the appearance of a disease becomes a serious matter, and often the cause of great loss. In nearly every important truck section serious diseases have appeared, and wherever they have been called to the attention of the Department an effort has been made to determine the cause, and if possible to suggest a remedy. The loss to the cucumber growers in the South Atlantic trucking regions and in the Mississippi Valley was heavy this year,



owing to the prevalence of bacterial wilt and downy mildew. Information was furnished to the growers relative to the means of controlling these two diseases. Considerable work was also done with watermelon, tomato, and cabbage wilt. The only way to control these wilt diseases is by the use of resistant varieties. In the case of the watermelon, the citron and some foreign melons have proved to be wilt-resistant, and hybrids between them and the native varieties were also resistant and immensely productive. An endeavor is being made to fix a type of these hybrids. We have also succeeded in obtaining resistant selections from American varieties. With tomato and cabbage a similar line of work has been started, with promise of success. Further tests of the variety of cowpeas known as "Little Iron," resistant to wilt and root knot, have been made during the year, and even in the worst infected soils this variety has proved perfectly resistant. It has been crossed with heavier yielding varieties, with the hope of obtaining improved strains.

#### CALIFORNIA VINE DISEASE.

Attention has been called from time to time to the progress that has been made in efforts to find a method of controlling the California vine disease, a malady the cause of which still remains unknown. Experiments with grafting stocks have been in progress in the center of the badly infected district for over eight years. These experiments have included the grafting of some 400 acres of vines, the enterprise being conducted in cooperation with leading viticulturists in California. The Lenoir vine is resistant to the disease, and its use either as a top graft or as a root upon which to graft other varieties has been found effectual in resisting the disease.

New varieties of grape, which have received Lenoir blood through hybridizing, have shown great resistance to the same disease.

So far as this experiment has gone, therefore, it seems probable that a satisfactory means of permanently overcoming the disease has been found.

#### TIMBER PRESERVATION AND SEASONING.

The work of timber preservation and seasoning has been conducted by the cooperation of the Bureau of Plant Industry and the Bureau of Forestry. The saving caused by improved methods of cutting timber to insure longer life has already been very great. In one instance about \$50,000 was saved in six months. Extensive tests were carried on in cooperation with railway, telegraph, telephone, and mining companies, to determine the amount of water evaporated from timber. Drying out timber according to methods suggested by the Department has led to a great saving in freight and increased length of life of the timber, besides resulting in a saving of labor in handling it. Various pre-

servative processes have been tested during the year, and considerable advance has been made in this art as the result of the Department's investigations. Our aim is to secure a process which will be so cheap and effective as to make it within the reach of even the small user of timber.

#### WORK WITH MUSHROOMS.

An industry of considerable importance has sprung up in this country in the growing of mushrooms for market; but so far it has not reached great proportions, owing to the fact that most of the spawn has to be imported. We also import in the shape of canned mushrooms about 2,300,000 pounds annually, principally from France. There is no reason why this important food plant should not be grown here to a sufficient extent to cover all our needs. One of the greatest difficulties of mushroom growers, both in this country and in Europe, has been the uncertainty of growing a productive spawn of high vitality, and so far practically only one variety of mushroom has been cultivated commercially. The Department has now discovered a simple and practical method by which we have produced a high grade of spawn, not only of the cultivated mushrooms, but of many of the wild sorts which it is desirable to cultivate. The perfection of a simple and effective method of propagation, as above stated, applicable to all varieties of mushrooms, is probably the most important step in mushroom culture that has ever been made.

#### DRUG AND MEDICINAL PLANTS.

The extensive importations of crude drugs, amounting to more than \$3,000,000 annually, have led to many attempts to cultivate drug plants in this country. In most instances this work, entered into by persons who were without adequate information in regard to the conditions required, has resulted in discouragement and loss. Experiments undertaken by the Botanist to determine the actual cost of producing, curing, and preparing for market certain kinds of crude drugs, especially leaves of plants like stramonium, indicate that they can not be produced profitably unless they may be grown where land and labor are cheap, and where the growing season is long. An experiment in curing the leaves with artificial heat gave very promising results, and if this method proves to be entirely satisfactory a great saving in time and labor will be accomplished in this part of the work, with the assurance of greater uniformity in the product.

The cultivation of golden seal, seneca snakeroot, and other similar native drug plants that are becoming exterminated in the wild state, has been begun on a small scale, to secure definite knowledge in regard to their life habits and to determine the conditions under which they may be cultivated. Owing to the increasing demand for them and

their rapid disappearance from the forests, their successful domestication is extremely desirable.

#### POISONOUS PLANTS.

The important results from the poisonous-plant investigations conducted by the Botanist in previous years have been followed by an increased demand for further work along this line. The annual loss of sheep from eating poisonous plants on the ranges of the Northwest has been estimated to exceed \$400,000. There are also very considerable losses among cattle and horses on the Western ranges, due to death camas, loco weed, and other poisonous plants. Besides a large amount of miscellaneous work in this direction, with the accumulation of important information in regard to various kinds of poisonous plants, special investigations have been made with two important groups—death camas and the lupines.

The excellent lupine forage, which has been avoided by many stockmen because they lacked knowledge of the character of its poisonous properties, may be utilized, providing certain precautions are regarded. Sheep must not be allowed to eat freely of lupines when coming hungry and thirsty from a dry, barren range. Some other food, preferably of a succulent character, and a plentiful supply of water should be given to animals grazing on lupines.

#### FIBER PLANTS.

The importation of vegetable fibers amounts to more than \$30,000,000 annually, and the quantity is continually increasing; yet it is scarcely sufficient to meet the demands of our increasing cordage and textile industries. There are areas in this country where soil and climatic conditions are as well suited to the growth of flax and hemp as anywhere in the world; yet nearly all of the flax fiber and more than half of the hemp fiber used in our manufactures is imported. To compete successfully with the foreign product, our farmers must produce a fiber of equal or superior quality at a relatively low cost. The first requisite for superior quality of fiber is an improved variety of the flax or hemp plant. With this object in view, seeds of improved foreign varieties are being imported, and selections of seed are being made from American-grown plants. Reduction in the cost of producing the fiber must be brought about mainly by the introduction of improved methods of handling the crops and the substitution of machinery for the large amount of skilled hand labor which has heretofore been regarded as necessary in the preparation of the fiber. Carefully conducted experiments are needed to demonstrate the practicability of new methods that will reduce the cost of production.



## IMPROVEMENT IN MANILA FIBER.

Manila fiber is the strongest and most important material used in the manufacture of the better grades of cordage. With a greatly increased demand during the past five years, and consequent high prices, a tendency arose among Philippine producers of manila fiber to sacrifice quality for quantity. Importations showed carelessness in preparing and in grading the fiber, a condition that threatened serious injury to the market for this, the most important product of the Philippine Islands. After careful examination of the fiber in the bales as imported, a report was forwarded to the Philippine government, by whom immediate action was taken and a thorough investigation made of the production of manila fiber in the field and its preparation for export. A law has been drafted by the Philippine government regulating the methods of cleaning the fiber, and also to provide for inspection of fiber to be exported. The higher standard of quality and the uniformity of grade assured under this law will not only result in great satisfaction to the manufacturers and users of manila cordage, but it will tend to still further increase the market for this most useful fiber.

## GRAIN-GRADING METHODS.

The inspection and grading of grain, which is a prominent feature of our grain business, has been the cause of some apparently well-founded dissatisfaction in both our domestic and foreign trade. The chief cause of this has been that grain inspectors have had, as a rule, no adequate means of educating their judgment, upon which they must rely for the greater part of their work, and the inspection departments have had no very satisfactory apparatus for settling disputed or appealed cases. During the past year the Department has developed an apparatus for determining the moisture content of grain, particularly corn. This apparatus, essentially an air bath and a delicate balance, enables any inspector or warehouseman to determine the condition and probable keeping quality of corn; since excessive moisture is the principal cause of deterioration in this cereal.

Methods of accurately measuring essential qualities and defects of any sample of grain are a necessary preliminary to a satisfactory system of grain grading. The Department is, therefore, endeavoring to learn what these essentials are for each class of grain and how they can best be measured, so that grain inspectors may have available the means to do their work with the highest possible degree of efficiency.

The general adoption of such methods is likely to be of great benefit to the grain trade, as it will naturally result in greater definiteness of rules for grades and more uniform work by inspection departments.



## FOREIGN COMPARED WITH DOMESTIC CLOVER SEED.

For the past two years cooperative work has been carried on between the Bureau of Plant Industry and several of the agricultural experiment stations to determine the relative value of foreign and domestic red clover. The seed raised in this country has given a larger yield of hay, though one sample from Russia gives promise of a good yield in the northern tier of States. Experiments will be undertaken to determine the relative feeding values.

## TYPE LOCALITIES AND CHANGE OF SEED.

The work done on foreign and domestic clovers shows that there is a marked effect on general thriftiness, yield, and earliness when seed from one locality is sown in another where it is subjected to different conditions of climate and soil. Under the present methods of handling in this country, the seed is all brought together at the large market centers, where it is bulked and graded according to appearance, without regard to place of growth. This seed is then distributed to the small dealers throughout the clover-growing area. While the indiscriminate mixture and change of seed resulting from this method of handling may prove beneficial in some cases, it is often undoubtedly a distinct disadvantage.

The seed of all of our grass and forage plants, as well as much of our vegetable and grain seed, is produced under similar conditions, thus preventing any knowledge of origin or special adaptability.

A thorough study should be made of our principal crops to determine the type or best locality for seed production, as well as the advantage or disadvantage of changing seed from one locality to another, and the limits within which this should be done.

A study should also be made of both the foreign and domestic seed production of the crops, of which we now import large quantities, so that the domestic production may be aided and encouraged as far as possible.

## DEMONSTRATION WORK WITH FORAGE CROPS.

The office of Grass and Forage Plant Investigations has put in the field a number of agents, whose duty it is to visit farmers in sections where forage plants are needed and arrange with them to grow a small area of some crop which is known to be valuable in that section. In this way much interest has been created in crops which were new or comparatively so, particularly in the cotton-growing States. As a result of this work, there is now a decided movement toward a diversified system of farming.

In addition to the above, a number of small demonstration farms have been established, on which various grasses and forage plants are grown,

under the direct supervision of officers of the Department. These farms are visited by large numbers of farmers who by this means acquire an interest in the crops and some knowledge concerning their cultivation and utilization. In other words, new and valuable crops are being rapidly introduced into many sections of the country where greater diversification of crops is needed.

#### WILD HAY.

In 1899, 15,457,000 acres of wild grasses were cut for hay in this country. During the present season the grasses thus utilized have been studied with a view to ascertaining their relative agricultural value. Much important information has been gained, and some of these grasses have been found which possess characteristics that will enable us to bring them into cultivation, particularly in the arid and semiarid regions of the West. We are now gathering considerable seed of four or five of the most important, with a view to introducing them on cultivated land.

#### LEGUMINOUS CROPS.

One of the most important movements which has occurred in American agriculture is now in progress. It is the general introduction of alfalfa as a hay and pasture crop. During the present season good crops of alfalfa have been grown by our experimenters in almost every State in the Union.

Other leguminous crops are receiving a large share of attention. The Department has secured some seventy-five varieties of soy beans, and has grown them for two seasons with a view to finding varieties adapted to different climatic conditions. Within another year we shall be ready to begin the introduction of a number of the best varieties. Varieties have been found adapted to practically all parts of the country.

The cowpea continues to receive a large share of attention in our demonstration work. We are attempting to add largely to the acreage of this important crop in the cotton States. Varieties have been secured adapted to the Northern States as well.

A number of new legumes have been secured and are being propagated with a view to obtaining seed for introduction work in the near future.

#### RANGE INVESTIGATIONS.

Fifty-eight square miles of typical range land near Tucson, Ariz., have been put under fence during the year. Careful studies are being carried forward on this area, with a view to determining the result of protecting the now exhausted range from the depredations of stock. In the State of Washington we have demonstrated that the mountain

ranges may be restocked with grasses by using seed. Our investigations have also shown that the ranges in that section may be so handled as to largely increase their productive capacity; but in order to do this it is believed to be demonstrated that it is necessary for those who graze stock upon the ranges to control a definite area of range land.

#### SOIL AND SAND BINDERS.

A representative of the office of Grass and Forage Plant Investigations during the past season studied the extensive work on soil and sand binding that has been done in Europe. After two hundred years of experience in Europe it has been shown that drifting sand can be controlled. Work has been undertaken with this end in view at The Dalles, Oreg.; Astoria, Oreg.; on the eastern shore of Lake Michigan, and at several points on the Atlantic coast. In many places these drifting sands have covered up extensive areas of valuable farm land. In other cases they have encroached upon cities, and have even buried portions of them. In still others they have interfered seriously with railroad traffic.

#### CASSAVA.

Studies by agents of the Department have shown that the cassava crop is of great importance in the region adjacent to the Gulf as a feed for cattle and hogs. This crop has been grown in a desultory way in Florida for nearly half a century. The value of the crop has been known, but there have been two principal difficulties in the way of its cultivation. The first is that it is propagated from sections of the stalk, and these are very difficult to keep during the winter season. Growers have now been found who have apparently solved this difficulty, and a number of the best methods of keeping the seed stems will be tested on a large scale by the Department this winter.

The other difficulty relates to securing a stand. It has been demonstrated that it is practicable to sprout the cuttings in hotbeds and transplant them into the field afterwards, and in this manner to secure almost a perfect stand, thus doubling the average yield. Arrangements have been made to give this method a thorough trial next season. The importance of this work will be better understood when it is known that an acre of cassava yields as much food value as 8 to 10 acres of corn in the section where cassava is grown.

#### POMOLOGICAL INVESTIGATIONS.

In no other country in the world has fruit culture attained such large proportions as in the United States. Favored with a broad range of latitude, affording great variety of soil and climatic conditions, there are but few fruits of the temperate zone that are not now produced on a commercial scale within our borders. The track of the pioneer has everywhere been marked by the planting of orchards and vineyards.

In certain regions the production of fruits and their products has become the chief feature of agricultural life, and the welfare of the people therein is largely dependent upon the successful production, harvest, and sale of such fruits as the peach, apple, grape, orange, and several others. In all such regions the question of adaptability of types and varieties to soil and climatic conditions, and their suitability for the purposes for which they are to be used, becomes a most important one from the economic standpoint. Unlike the grower of grain or vegetables, the orchardist or vineyardist must invest years of time and labor, in addition to the original outlay for land and stock for planting, before his plantation attains sufficient age to begin to yield a return. It is therefore of the utmost importance that there should be accessible to him information regarding the distinct characteristics of fruit varieties, their particular requirements as to soils and climate, their times of ripening, and suitability for particular uses, such as shipment to distant markets, use in canning, drying, preserving, etc. One of the important duties of the Pomologist and the force engaged under him, is to accumulate and interpret the results of individual experience along these lines throughout the country, so that it may be furnished to the interested public in convenient form for their guidance in fruit culture.

#### FRUIT MARKETING AND STORAGE.

Some of the most pressing and important questions relating to the fruit industry are those that grow out of the present tendency in horticulture to produce each fruit in that section where it can be grown best or to mature at a certain desired time, even though that locality be thousands of miles from the market where the product will be consumed. These problems may be characterized as those relating to marketing and storage. Their solution lies at the foundation of development of important export trade in fruits, and is hardly of less moment in connection with that portion of the crop which is used at home.

Some of the questions involved are with regard to the best methods of harvesting, grading, packing, and transporting each fruit, with reference to accomplishing its safe and economical delivery at its desired destination; also with regard to the suitability of the variety, packing and package, to the needs of the consumers, who are to be the purchasers if profitable trade is to be built up. These questions are of especial importance in connection with the export trade, and a series of experimental shipments is being made to obtain light upon these points.

Through these experiments, which have been conducted on a commercial scale, chiefly through the ordinary channels of trade, it has been demonstrated that the Bartlett pear, a choice but perishable



fruit, of which there is frequently so large a surplus in our Eastern States as to depress prices to a point where the producer receives little return for his labor, can be successfully and profitably shipped in refrigeration across the Atlantic and sold at prices that yield a good net advance over home value.

Elberta peaches from Georgia and Connecticut, and several varieties of summer apples from Delaware, can be landed in London in prime condition when the climatic conditions at time of shipment are favorable; and they are likely to meet with good demand at fair prices.

It is gratifying to note that commercial shippers are following the work of the Department along these lines with keen interest, and preparing to make extensive shipments of such fruits as are found capable of profitable handling in this way.

A notable event of the year was the inauguration of direct shipments of American winter apples to Paris through the instrumentality of the Department. As was anticipated from previous investigations made by the Department, russet varieties were found to have preference to red apples in that market, and where sound and free from blemish were in good demand at high prices. The opportunity to develop trade in this line appears excellent.

Numerous and comprehensive tests of other fruits are under way, and may be expected to yield decisive results in due time.

The storage of fruits at low temperatures to retard their ripening and decay for a sufficient time to permit them to be handled to the mutual advantage of the grower and the consumer has assumed very large proportions in this country, chiefly within the past decade. It has been demonstrated beyond question that all fruits destined for preservation in cold storage should be stored quickly after removal from the tree; a uniform temperature of 32° retards the ripening processes of apples, pears, and peaches more than higher temperatures, without any noticeable injurious effect upon their flavor. It has also been demonstrated that certain delicate fruits, like the Bartlett pear and the peach, which ripen in hot weather, require quick cooling after entering the storage room, and that this can probably best be accomplished by storing in small rather than large packages.

#### STUDIES OF GRAPES AND GRAPE GROWING.

In addition to continuing the work of thoroughly testing the large number of varieties of European table grapes in the cooperative experimental vineyards in North Carolina and Florida, a comprehensive investigation of certain viticultural problems relating to the vine industry of the Pacific coast has been started.

The rapid and extensive development of grape culture in California is one of the most striking features of our fruit industry. Based

almost exclusively upon the European grape species, as it is, vineyard methods modeled after those of the Old World are more successful there than in the vineyard regions of the Eastern States, where the native species of grape are the main dependence. The fertile soil and favorable climatic conditions in California have in general resulted in large yields and good profits to the grower.

Certain serious difficulties have arisen, however, which require immediate attention. Among these may be mentioned the general infestation of the important vineyard sections with the destructive *Phylloxera*, which preys upon the roots of the European grape. The general principles of the method of combating this insect through the use of resistant stocks have been demonstrated by entomologists, but the practical application of these involves many important vineyard problems which properly fall to the viticulturist. Among the most important of these is the relative adaptability of the known resistant stocks to the leading vineyard soil types and the congeniality of the principal commercial varieties of foreign grapes to these resistant stocks.

In cooperation with the California Agricultural Experiment Station and the office of Seed and Plant Introduction of the Bureau, experimental vineyards have been established at Fresno and Oakville in connection with this work.

#### WORK AT THE ARLINGTON FARM.

##### APPLES AND PEACHES IN NURSERY.

There are now growing in the nursery some 400 varieties of apples, the scions of which have been secured from bearing trees known to be true to name. The peach list embraces 150 sorts chosen with equal care. These collections have been carefully selected to represent the sorts now commercially grown in the several important apple-growing regions of the United States, together with a carefully chosen collection of varieties which show promise of becoming additions to the commercial list.

The aim of these plantations is that they shall form a basis for the comparative study of varieties when grown under like conditions, in order that the influence of climate on horticultural varieties may be observed, to afford basis for taxonomic studies upon cultivated varieties, and to furnish fresh fruits for comparative studies and identification of varieties, as well as material for further extending physiological studies upon the keeping of fresh fruits in artificial storage.

##### ORNAMENTAL TREES IN NURSERY.

The nursery at present contains several thousand seedling oaks, ashes, and maples, which have been grown from seeds gathered from

trees of note in the District of Columbia. These trees, if sent to schools, parks, and other outdoor improvement organizations of the country, will prove objects of interest, and will be appreciated because of the sentiment attaching to the place of their origin.

#### EXPERIMENTAL FRUIT PLANTATION.

A further fruit plantation upon the Arlington Farm, consisting of 1,000 trees, is designed as a basis for studying the physiological action of the various insecticides and fungicides upon the health and longevity of trees.

#### CRANBERRY PLANTATION.

A small typical cranberry plantation is being established upon the farm, in order to determine the adaptability of the plant to the climate and the lowlands lying along the streams of eastern Virginia and Maryland. There are many thousands of acres of land now lying idle that might be made remunerative by the introduction of this crop if it proves suited to the conditions.

#### ARBORETUM.

An area of some 30 acres adjacent to the buildings which are in course of construction upon the farm is being prepared as an arboretum, in which will be arranged in an instructive, as well as artistic, manner all the native and exotic trees and shrubs which can be grown here. One of the chief reasons for beginning this line of work upon the Arlington Farm is that in this latitude there is an overlapping of the Northern and Southern floras of the United States, which allows the successful growing of a much greater range of species than can be cultivated either farther north or south.

#### THE POTOMAC FLATS TESTING GARDEN.

##### SWEET POTATOES.

An extensive variety collection of sweet potatoes is being grown on the Potomac Flats area. In fact, all of the commercial forms and types of the plant known have been assembled and are being raised, both upon the sandy soil of the flats and upon the clay loam of the Arlington Farm; also at one station in Alabama, one in New York, and three in Ohio, selected to cover the glacial drift soil of Ohio, the glacial drift of New York, and the prairie soil and alluvial river deposit soil of Ohio. The variety collection is designed to afford an opportunity for taxonomic studies, while the growing of the crop upon various soils is intended to give an idea of the influence of soil conditions upon the development and culinary properties of the root.

## CELERY.

Celery is receiving special attention. It is being grown under various soil and moisture conditions, from various dates of seed sowing, and under the influence of various commercial fertilizers, in order to learn, if possible, the particular factor in environment which determines pithiness, if it is a question of environment rather than an inherited tendency transmitted by the seed of certain strains and varieties.

## EFFECTS OF SHADE ON CROPS.

The physiological effects of shade are so marked and are of such commercial value that the horticultural work of the Department will be extended to cover a test of all truck crops which offer any advantages from being grown in shade. The work of the present season has been largely confined to the use of cloth and slat shades upon celery, cauliflower, lettuce, cucumbers, and radishes. As rapidly as the facilities of the Department will permit, all the truck plants which are grown for leaf production will be submitted to the influence of shade. In connection with this work the atmospheric and soil conditions will be carefully studied, with the hope that the reason why plants behave in a different manner under shade from what they do in the open may be determined.

## BEET-SUGAR INDUSTRY.

The beet-sugar industry is developing satisfactorily. In 1896 29,220 tons were made; one year ago 220,000 tons were made. Careful estimates put the crop now being worked up at 260,000 tons. This is a more rapid development than has taken place in sugar making with new conditions in any other country. The future of the crop depends upon the adoption of economic methods in field and factory. The growing of seed in the United States of a superior quality is assured, which will result in much richer beets and better yields than from imported seed that is never first class. Heavier tonnage per acre will come from better farming, and more economy from intelligent disposition of the by-products. The industry is well established.

## TEA-CULTURE INVESTIGATIONS.

During the year the work on growing tea has been continued at Summerville, S. C., and a new station has been put in operation at Pierce, Tex. At Summerville further work has been carried on in the testing of new varieties, new machinery, and new factory methods. The work at this point has now reached a state where more attention can be given to the improvement of the teas after being harvested. To this end a number of physiological and chemical studies have been



made of the product at different stages with a view to improving methods of curing and increasing the flavors and aromas of the teas. The new methods and apparatus introduced by Dr. Charles U. Shepard, and used in the manufacture of green teas, have proved most satisfactory. Experiments have been carried on quite successfully in the preparation of tea tablets. These tablets are prepared in a special machine of great power, the result being a firm, polished product, which readily falls apart in boiling water. Improvements have been made in the matter of polishing and finishing the teas, all of which will add value to the American product. Despite the fact that the season has been a very unsatisfactory one for a number of reasons, the yield of tea will probably approximate 9,000 pounds, or about what was raised last year. A favorable season would have given a much larger production.

At Pierce, Tex., cooperative arrangements have been made with Mr. A. P. Borden, who has placed at the disposal of the Department a large tract of land suitable for tea growing, and has arranged to provide buildings and a portion of the labor. The Department has an experienced man located at this station, and is making preparations to put out at least 50 acres of tea the present autumn. It is planned to set out at Pierce at least 100 acres and extend the plantation as the funds permit. The labor question plays an important part in this work, but it is believed that conditions are such in southern Texas that proper labor can be secured without difficulty. Altogether, the tea investigations are in quite a satisfactory condition.

#### FARM MANAGEMENT.

In my last report I pointed out the work the Department was inaugurating in the matter of farm management. It was there shown that efforts were being made to bring together certain facts relative to the methods of managing farms in certain typical sections of the country, the object being to use this information in improving agricultural conditions where the best processes had not been followed. There is a great deal of valuable work to do in this connection, and there is no question that systematic studies along this line will greatly aid in the advancement of agriculture. In every community and in every section there will be found farmers who are much more successful than others. There are reasons for this, and it is these reasons that the Department is endeavoring to determine, so as to point the way for others to follow along the same successful lines.

Closely associated with this work are the demonstration experiments which the Bureau of Plant Industry is conducting. These have for their object the demonstration of the value of certain crops and certain methods over those which may be in use or existing at the present time. As an example of this kind of work, may be cited what is

being accomplished in the introduction of alfalfa and other important forage crops into the South and sections of the country where such crops have not already been grown.

### BUREAU OF FORESTRY.

The object for which the Bureau of Forestry exists is first of all to secure the highest permanent usefulness of the forests in the present and future interests of the country. Among our great industries, the lumber industry now stands fourth in importance.

Lumbering of the forests now standing must go on to supply immediate needs. This has made it necessary to find how to make conservative lumbering profitable, and the great danger has been that the rising price and growing scarcity of lumber would not of themselves bring this about until none but inferior forests should be left on which to practice forest management.

It is a safe assertion, that the lumber interests of the United States recognize to-day as never before that forestry has for them a practical commercial value; that the way is in many cases already open to them to consider conservative lumbering as a definite business proposition; and that this condition has been brought about entirely by the efforts of the Bureau of Forestry to deal with the concrete facts of a problem of National importance. The evidence of its success is not only the cases in which lumber companies have already begun to put into operation its plans, prescribing for particular tracts how to lumber with reference to future production, nor the applications which have been made for similar advice elsewhere, but to the surprising interest in the subject which has lately been evidenced among lumbermen generally.

It is greatly to be hoped that the Bureau of Forestry may not be compelled to let slip this opportunity for an important public service by inability to answer the demands which will be made upon it. Experience has shown its capacity to do this work. The wide knowledge of forest conditions and of methods of operation which it has gathered, and the organization which it has developed, fit it to undertake new problems with a probability of success which can be looked for in no other quarter. In so vast a country as ours, and under forest and economic conditions of such variety, the task of revolutionizing the long-established methods of an industry like the lumber business is one of enormous difficulty. On the ability of the Bureau of Forestry to demonstrate, as fast as opportunity permits, that it is good business for lumbermen to conduct operations with reference to future crops, depends in large measure the success or failure of the attempt to preserve what should be our chief sources of timber supply. The proper equipment of the Bureau for this work is nothing

less than a National duty, and I have recommended that the annual appropriation for its use be substantially increased.

#### ADVANTAGES OF COOPERATION WITH PRIVATE OWNERS.

In cooperating with private owners the Bureau is not expending public money to benefit private interests. Scientific forestry—that is, enlightened management based on an accurate forecast of what a forest can be made to produce in the future—is impossible without full knowledge of all the forces, natural and artificial, which affect its productiveness. This involves a careful study of lumbering methods on the one hand and of the forest itself on the other. The Bureau has now in its possession as the result of this cooperative work the tabulated results of studies in many States from Maine to California and from Florida to Washington, representing a total of recorded individual measurements in the forest, the number of which would mount to scores of millions.

This vast mass of material has been gathered mainly at the private expense of the owners, who have received the expert assistance of the Bureau. Its possession makes it possible continually to enlarge the field of forestry. It has been secured by making its accumulation go hand in hand with practical results. Every working plan prepared and put in operation has meant both the preservation of a source of National wealth and an addition to the knowledge necessary for the wise use of the public as well as the private forests of the land.

Two considerations must be urged in connection with present conditions. The first is that cooperation is now supplying the Bureau with what it needs for Government work at a less cost than would be required to secure the same result independently. The second is that the speedy introduction of management on private lands is a matter of pressing importance. Forest preservation is necessary in the interest of the public welfare. Forest destruction on a large scale is now in progress. It can be checked only by showing that it is possible to use the forests without destroying them. The Bureau of Forestry is doing this, and there is no other agency which can do it. If the Bureau does not put forth every endeavor to introduce conservative management among private owners, the public interest will suffer.

While it is true that hitherto virtually everything that has been done in this country to introduce conservative management as a paying business has been done by the Bureau, it is far from my wish that the Bureau should continue to control operations for private owners any longer than there is a clear and imperative need. It has already entered on the policy of detaching from its staff competent men to take charge of private operations when called upon to do so, in spite of the fact that it needs the services in its own work of all the trained



foresters it has as yet been able to secure. The Government service, however, is the natural goal toward which most ambitious students of forestry will strive because of the superior opportunities of training which it affords.

#### SCIENTIFIC INVESTIGATION OF FOREST PROBLEMS.

There is danger that the attention which the work of the Bureau in promoting the actual management of forests naturally receives may obscure the importance of the investigations which it is conducting along other lines. These investigations are largely scientific in scope and method, but always entirely practical in purpose and outcome. The Bureau is the recognized source of information for the country on all forest subjects. The volume of its great and growing correspondence due to this is one evidence of its usefulness. It is conducting experiments along lines which have received the enthusiastic approval of engineers, constructors, and the like, to determine the strength of timbers. It is discovering how to treat cheap woods with preservatives so as to make it commercially practicable to substitute them for more expensive kinds, thus virtually adding new sources of valuable supply. It has inaugurated a new method of gathering crude turpentine which has revolutionized within a single year the naval stores industry of the United States, with an annual output of \$13,000,000 worth of turpentine and rosin, whereby the yield of turpentine is nearly doubled with practically the same expense for labor, and the life of the tree which yields the turpentine is greatly prolonged.

In the fall of 1902 this new system had been experimentally in commercial use for a single season on the tract of one operator in Georgia. To-day the men who conduct three-fourths of the operations in the whole Southern pine belt have adopted it, or are waiting to adopt it as soon as their orders for the necessary apparatus can be filled.

#### FOREST MANAGEMENT.

While the growing willingness of the private owners, in whose hands are the great bulk of the forests of the country, to inquire into the possibilities of forestry in connection with their holdings has opened an opportunity for educational work, the value of which it is hardly possible to overstate, a larger proportion of the energies of the Bureau has been given during the past year to introducing forestry on public lands than ever before.

In accordance with the provisions of the so-called Morris bill, selection has been made and approved of 104,159 acres out of a total of 225,000 acres of land in the Chippewa Indian reservations in northern Minnesota, which will constitute the Minnesota National Forest



Reserve. Official announcement of the second selection will soon be made. Selection of ten sections to be reserved from sale and settlement has also been made and approved. Volume tables and estimates of the total stand of the forest have been prepared, upon which will be based recommendations for the reservation from lumbering of 5 per cent of the timber for seed trees, as the act provides. Trees which will not be cut when the forest is lumbered have been marked on more than 6,000 acres, and rules which will control the lumbering have been prepared and have been approved by the Secretary of the Interior.

A working plan for the tract of the United States Military Academy at West Point was prepared at the request of the Secretary of War. The forest, which consists of hardwood sprouts, is in poor condition, the result of numerous fires and injudicious cutting. The plan is accompanied by forest maps, which show the location and area of the various types of forest, and provides for fire protection and for such improvement cuttings as will again put the forest in a sound and healthy condition. This plan is now being put into effect under the supervision of the Bureau of Forestry.

At the request of the Secretary of the Interior working plans were prepared for three Indian reservations in Wisconsin, which include recommendations for their protection from fire and rules under which they shall be lumbered without unnecessary damage to the forest.

#### ADVICE FOR PRIVATE OWNERS.

Ninety-four applications for assistance in managing forest lands were made by private owners. Of these applications 37 were for timber tracts and 57 for wood lots. Since the Bureau put into effect its cooperative scheme of assisting private owners, applications have been received for advice in the management of 5,656,171 acres. Farmers and other private owners of small tracts of woodland throughout the Northeast, the Middle West, and the South Atlantic States have applied in increasing numbers for the assistance of the Bureau in the management of their tracts. Fifty-eight working plans for wood lots were prepared last year.

#### STUDIES AND WORKING PLANS.

Field studies of five large timber tracts were made as follows: On 39,000 acres in Berkeley County, S. C.; on 2,321 acres on the Susquehanna River above Harrisburg, Pa.; on 16,000 acres in Mitchell, Caldwell, and Watauga counties, N. C.; on a Longleaf Pine forest in southeastern Texas, involving field work on 300,000 acres, which occupied 35 men for four months; and on 125,000 acres in northwestern Maine, which occupied 32 men for three and a half months.

Working plans are in preparation for the following tracts: A forest of 25,000 acres in Sullivan County, N. H.; a forest of 50,000 acres in West Virginia; and a forest of 3,000 acres in Grafton County, N. H.

The forest of R. C. Neal, near Harrisburg, Pa., for which a working plan was prepared last year, is now under conservative forest management. Two field assistants of the Bureau are supervising the lumbering operations of a large company in Newton and Jasper counties, Tex. The working plan for the United States Military Academy at West Point is now in operation. Twenty-seven wood lots in the Northeast and South Atlantic States are being managed in accordance with the recommendations of the Bureau. The first selection of the Minnesota National Forest Reserve, consisting of 104,459 acres, is now under the Bureau's supervision. In addition to these lands, 679,194 acres of private lands and 106,759 acres of public lands not included in forest reserves are under forest management.

The interest which large railroad companies have recently exhibited in the practice of forestry is one of the most encouraging developments of the year. Many of them have made application to the Bureau for its cooperation in studies whose results would determine the advisability of the purchase and management of forest lands for the production of railroad ties and other timbers. Forest work for railroads offers very great opportunities for useful work.

Cooperative studies of State forest conditions, in which the States shared in the expense of the work, were made for Maine, New Hampshire, and California. In Maine the forests of Piscataquis County, south of Moosehead Lake, were studied. The results of the work were presented in the Fourth Report of the Forest Commissioner of that State. In New Hampshire a study of the forests of the entire State was begun, with the purpose of determining the methods by which they may best be preserved. In California the work was directed toward the making of a forest map of the State, the determination of practical modifications in lumbering methods, and of the effects of grazing and fire, and other matters entering into the determination of a State forest policy.

Studies were made of the Sugar Pine in California, the Lodgepole Pine in Montana, commercial hard woods in West Virginia, North Carolina, Tennessee, and Kentucky, the Balsam in the Adirondacks, the Chestnut in southern Maryland, and the Red Pine in northern Minnesota.

The section of Forest Measurements, without increase of force, accomplished nearly twice as much work as in the previous year.

#### WORK FOR THE COMING YEAR.

The work of the section of Forest Management for the ensuing year includes more important undertakings than ever before. Technical problems involved in the management of the National forest reserves must be solved; the field work in Texas, in South Carolina,

and in Alabama must be completed. Much work remains to be done on wood lots for private owners. On the lands to be included in the Minnesota National Forest Reserve those trees must be marked which are to be reserved in the lumbering, and supervision of the lumbering operations must be exercised by the Bureau. The study of the forests of California and of New Hampshire remains to be completed, and a study of Vermont forests will be undertaken. Commercial tree studies will be made in Maine, Minnesota, and the Southern States.

#### FOREST INVESTIGATION.

A notable accomplishment in the South during the year has been the extensive introduction of the cup and gutter system of extracting turpentine. This system, invented by Dr. Charles H. Herty, working under the Bureau's direction, although in operation only a year, is rapidly replacing the old, destructive system of boxing trees. Its great superiority is due to the fact that it is far less destructive than the box and that it yields at least 40 per cent more turpentine.

#### INVESTIGATIONS IN 1903.

Forest investigations were carried on in the following States:

In Maryland, a study of the distribution of the forests of St. Mary, Prince George, and Kent counties, in cooperation with the State Geological Survey.

In Texas, a study of the forest growth of the Edwards Plateau and its influence on stream flow.

In Missouri, a study of the swamp forests, including such timbers as Bald Cypress, and Red, Black, and Cotton gums.

In California, a study of the Tan-bark Oak in connection with the tan-bark industry.

In Ohio, Iowa, Michigan, and Montana, a study of forest distribution.

An investigation of the cedar-shingle industry was carried on in the Pacific Northwest, which included a study of the supplies of shingle cedar, the rate of consumption, etc.

The dendro-chemical laboratory, which was conducted in cooperation with the Bureau of Chemistry, obtained much valuable information in its study of gums and resins, the production of tannins, the use of different woods for pulp manufacture, the effects of poisonous chemicals on the life of trees, and the detection of adulterants in turpentine.

The life history of various insects harmful to trees in the East, South, and West was studied by the division of Forest Entomology in cooperation with the Bureau. It has been estimated that insects destroy every year \$100,000,000 worth of timber. Experiments were carried on in methods of lessening this great damage.



Studies were made of the basket-willow industry and of the maple-sugar industry, and bulletins on both subjects are now in preparation.

#### WORK IN PROSPECT.

Work in forest investigations for the ensuing year will include—

Bulletins containing descriptions of the trees of the Northeastern, Southeastern, Rocky Mountain, Southwestern, and Pacific slope regions.

An attempt to clear up the confusion in the common names of trees.

A study of forest distribution in two counties of Maryland.

Special studies of forest distribution in Missouri and Arkansas.

A study of the Big Tree of California; of the acacias of the Southwest; and of the uses, structure, and characteristics of various American timbers.

Further experiments in turpentine orcharding under the cup and gutter system, to determine the minimum wound which it is necessary to inflict on the tree, the forest conditions which make for the highest productiveness, and the like.

A forest exhibit at the World's Fair, St. Louis.

#### FOREST EXTENSION.

Plans for tree planting were made for 68 applicants in 29 States. These plans, which involved the examination of 40,557 acres of land, were made in accordance with the cooperative plan inaugurated by the Bureau. Most of the plans were for farm wood lots of not more than 10 to 20 acres, but there were several notable exceptions. A plan was prepared for 108 acres on the Presidio Military Reservation of San Francisco. Planting plans were prepared for the grounds of the State institutions of North Dakota, at the request of Governor White. Other plans were prepared for farmers in the prairie regions along the Fort Worth and Denver City Railroad at the request of that company, and more than 600,000 trees were set out.

A planting plan was prepared for 640 acres in Cullman County, Ala., formerly covered by Longleaf and Shortleaf Pine. It was recommended that Loblolly Pine and White Oak, Post Oak, and Chestnut be planted on the land.

Men applying for planting plans show everywhere a disposition to follow the recommendations of the Bureau. Planting plans previously made are being carried out with encouraging prospects of success.

Tree planting continues on the Dismal River Forest Reserve of Nebraska and the San Gabriel Forest Reserve of California. The boundaries of the Dismal River Reserve have been surveyed and marked. Eighty acres of bottom land adjoining the reserve have been fenced, and part of the land converted into a tree nursery with space for the growing of 2,000,000 plants. Many thousands of Western



Yellow Pine and Jack Pine seedlings were collected in the Black Hills and in Minnesota for planting in the Dismal River Reserve. On the San Gabriel Reserve much experimental planting was done on widely scattered areas. The planting was done mostly with pine seeds in seed spots. The total cost averaged \$7.41 per acre.

The natural reproduction of deficient forests has been studied among the hardwoods of Oklahoma, the Western Yellow Pine on the Prescott Reserve of Arizona, and the White Pine on the abandoned fields and pastures of New England.

A very important branch of the Bureau's work is the study of forest fires, with a view to discovering practicable means of reducing the immense losses due to this cause. The year covered by the present report was characterized by fires of extraordinary severity both in the East and in the West. The investigation of those which occurred in the East in the spring and early summer of 1903, however, was not begun in time to fall within the scope of the present report. The great forest fires of September, 1902, in Washington and Oregon were the subject of a special investigation by the Bureau, which discovered a total loss estimated at \$12,767,100. The Bureau's investigation showed that most of the destruction was due to carelessness and might easily have been avoided. Forest fires were studied also in Georgia, Florida, and the Lake States, with a view to discovering their causes, methods of prevention, and the total amount of damage they do.

Examinations of the Atlantic Coast and Columbia River sand dunes were made in order that methods of tree planting might be discovered to restrain the encroachments of the shifting sands. Tree-planting plans for sand-dune regions on the Atlantic coast are in preparation, and a strip of sand-dune land in Oregon has been withdrawn for experiment.

Work for the ensuing year will include:

A continuation of cooperative work in tree planting among private owners.

Tree planting on Pikes Peak, Wichita, Prescott, and San Bernardino forest reserves.

Improvement of natural reproduction on Pikes Peak Reserve and on lands in northern New Mexico.

Extension of the timber belts of Kansas.

A study of the methods of restocking cut-over pine lands in southern Michigan.

A continuation of the study of second-growth White Pine in New England.

A cooperative study with the State of California in improving the stands of timber.

A study of the Eucalypts.

The suppression of forest fires and the reclamation of shifting sands will continue to receive the attention of the Bureau.

#### FOREST PRODUCTS.

A work of great scope and importance undertaken by the Bureau is the determination of the strength and durability of the merchantable timbers of the United States. The investigation consists of tests of timbers performed in cooperation with the Bureau of Chemistry. The work is directed toward the solution of practical problems of interest to engineers, and has been approved by many prominent engineers, manufacturers, and lumbermen. These tests are being conducted in laboratories at Washington, New Haven, Conn., and Berkeley, Cal., on Red Fir, Western Hemlock, and Longleaf and Loblolly Pine.

Wood preservation forms a most valuable feature of the work of the Bureau. Railroad companies have eagerly followed the results of this work, since it has so important a bearing on their interests. The work consists in experiments in methods of seasoning and preserving construction, railroad, and other timbers so as to increase their strength and their lasting powers. A special feature of the work which gives great promise of success is the experiments with cheap substitutes for valuable woods used for railroad ties. Such work has been done with the Lodgepole Pine in Montana, with gums, birches, and inferior oaks in Pennsylvania, Kentucky, Arkansas, and Mississippi, and with Loblolly and Shortleaf Pine in Texas. Methods of seasoning Chestnut poles were studied in cooperation with the American Telegraph and Telephone Company.

Examinations and reports dealing with technical problems in the management of forest reserves have been made for reserves in Utah, California, Oregon, and New Mexico. Twenty-nine agents of the Bureau this summer examined more than 20,000,000 acres proposed as forest reserves in the Rocky Mountain and Pacific coast States.

#### FORESTRY RECORDS.

Extensive improvements have been made in the equipment of the forest library. Many books, pamphlets, and clippings have been added, and the whole library has been completely classified and indexed. The collection of photographs has been increased by 3,417 views, taken in 41 States and Territories and in many foreign countries. The mailing list of the Bureau has increased by 75 per cent. Eighteen new publications were sent out, of which 237,000 copies were printed. Besides these, 23 press bulletins and reprints of 14 publications were issued.

## BUREAU OF CHEMISTRY.

## NEW INVESTIGATIONS.

## EFFECT OF PRESERVATIVES AND COLORING MATTER UPON HEALTH.

As numerous experts of high character have declared both for and against the wholesomeness of many common food preservatives, and as the law authorizes the Secretary of the Treasury to exclude from the country food products to which any injurious substance has been added, the necessity for an investigation of these differences of opinion and the establishment of a wise and just conclusion in regard to them is apparent. To this end, as well as for the information of the public, an elaborate series of experiments has been inaugurated. It is evident, in view of the work previously done in this line, that neither mere theorizing on the chemical and physical properties of preservatives and coloring matter nor experiments upon other animals than man can lead to definite results. With this in mind an experiment was developed as follows:

Twelve young men, who responded to a request for volunteers, pledged themselves to use no other food or drink than that provided for them, with the exception of water, any water not used at the table to be measured and reported daily; to continue to be for at least six months members of the "hygienic table," and during this time to observe implicitly all rules as to diet, exercise, smoking, etc., laid down for them by the Chemist.

A period of rest was effected by placing six of the men at the observation table and the other six at the recreation table alternately throughout the period of seven months. Each experimental period varied from thirty to forty days, and was divided into a "fore period" of ten days, during which a standard ration for each man was determined; a "middle period" of from ten to fifteen days, during which time each member ate the ration previously determined, together with the added preservatives, which in this experiment were borax and boracic acid; and an "after period" in which the same ration was continued, but the preservative withdrawn, the object being to restore the body to its normal weight in case it had been disturbed by the preservative.

A daily record was made on blanks furnished each member of the table of the following data: Weight, pulse, temperature, all data connected with the income and outgo of the food, and an account of all the foods taken and the meals at which they were eaten.

By analysis it was possible to determine just what part of the food was consumed in the production of heat and energy within the system, provided the weight remained constant. Furthermore, any failure on the part of the individual to observe the pledge to partake of no food or drink except what was served at the hygienic table would have been at once disclosed by a disturbance of the balance sheet.

Such in brief was the nature of the experiment conducted. The mass of analytical data obtained is now in the hands of the calculators, and these data, together with such conclusions as an unprejudiced judgment would approve, will shortly be published. The recording of the facts as they occurred and the tabulation of the figures in the most scientific manner possible will present to experts a basis for conclusions. The experiment is to be continued, taking up the most important preservatives in turn, salicylic acid being the next to be considered.

#### INSPECTION OF IMPORTED FOODS.

Looking to the enforcement of the pure-food law, enacted March 3, 1903, and going into effect July 1 following, preliminary arrangements were made with the Secretary of the Treasury and the Secretary of State by which their active cooperation was secured. The Secretary of State issued directions to the United States consuls that special declarations concerning imported foods be made and forwarded to the Secretary of Agriculture, and through the Treasury Department the collectors of customs at the leading ports in the United States were instructed as to the steps necessary to be taken in sampling such cargoes as might be detained for examination and the reshipping or destruction of such shipments as might, upon analysis, be excluded from the country under the terms of the act.

#### TABLE SIRUP FROM ORDINARY SUGAR-PRODUCING PLANTS.

The investigations previously made in the Division of Chemistry, and the testimony submitted before the committees of the House and Senate charged with the investigation of the adulteration of food products, show that table sirups are generally adulterated in a degree corresponding to the price paid for them. Glucose is the material commonly used for the basis of this product. In this way the price of the genuine articles has been depressed to a point which renders their profitable production problematic. To combat this condition an investigation has been instituted to study the methods in vogue for the manufacture of table sirups, to ascertain how the product can be improved, and to conduct experimental work in the growing and fertilizing of sugar cane to determine methods for securing the highest financial returns. An elaborate fertilizer experiment was conducted on the farm of Mr. W. B. Roddenbery, at Cairo, Ga., from which practical results of a valuable nature were obtained and reported in Bulletin No. 75, Bureau of Chemistry.

The manufacturing data, obtained largely at the factory of J. T. Wells, Guyton, Ga., will be published in a separate bulletin when the additional experimental factory work now going on at Waycross, Ga., is completed.



## COLLABORATIVE WORK WITH EXECUTIVE DEPARTMENTS.

The collaboration authorized by Congress between the Bureau of Chemistry and such departments of the Government as may apply to the Secretary of Agriculture for chemical analyses has extended until it includes almost every branch of the service, the most extensive work having been conducted in connection with the Treasury Department. This collaboration included the sugar tests made on samples received daily from the appraisers' laboratories at New York, Boston, and Philadelphia, which comparative tests, extending as they have over a period of three years, have been productive of the most useful results in eliminating wide differences existing in the polarizations made at the ports named.

Other examinations made for the Treasury Department include an investigation of the percentage of ethyl alcohol in certain fusel oils imported into the country; an examination of the natural content of sugar in pineapples imported from different parts of the world; and the analysis of samples of ice and water intended for drinking purposes in the Bureau of Engraving and Printing.

Examples of cooperative work with other Departments are examinations of coal for the National Hospital for the Insane, at Washington, D. C., and paper for the Geological Survey, made at the request of the Secretary of the Interior; the examination of beverages offered for sale in Indian Territory, made on the request of the Attorney-General; samples of glue offered on competitive bids to the Government Printing Office; and a large amount of miscellaneous work for the Post-Office Department, including examinations of paper, ink, and stamps.

It is evident that work of this character, and especially such part of it as relates to the awarding of contracts, gains in uniformity and authority by emanating from one laboratory, and at the same time is more economically performed. The appreciation of this fact is seen in the constantly increasing number of requests received from other Departments for such work.

## WORK OF THE LABORATORIES.

## THE FOOD LABORATORY.

Upon this laboratory has devolved the greater part of the analytical work necessitated by the experiments with food preservatives, involving the examination of 5,500 samples, as well as all cooperative work on foods, such as pineapples, and the fermented beverage and fusel oil investigations. In addition, an exhaustive study of olive oil and its adulterations has been completed; a study of the composition of apples with special reference to changes in composition during ripening under different methods of cold storage has been continued in collaboration

with the Pomologist of the Department; and 134 samples of fruit sirups and nonalcoholic beverages were secured in the open market and analyzed. The grape juices show a great improvement in the methods of preservation since the study made of them several years ago.

As heretofore, important work has been done in this laboratory in connection with the Association of Official Agricultural Chemists and the food chemists throughout the country in the investigation and comparison of methods for the analysis of foods. Two members of the staff have also done considerable work as associate referees on sugar for this association.

During the year a compilation of the pure-food laws of the various States was issued in five parts.

#### INSECTICIDE AND AGRICULTURAL WATER LABORATORY.

About 1,500 analyses were made in this laboratory, including the following lines of investigation: Mineral and irrigation waters; sanitary examinations of water; insecticides; the arsenic content of wall papers, furs, etc.; cattle foods; and toxicological examinations to determine whether bees are killed by poisons used in spraying. Most of these results, bearing directly as they do upon public health, either have been or will be reported in bulletin form. A portion of this work is performed in cooperation with the office of irrigation investigations and the Division of Entomology. Considerable work on methods of analysis for insecticides has been done by the chief of the laboratory as referee in the Association of Official Agricultural Chemists.

#### THE SUGAR LABORATORY.

In this laboratory the work on sugars for the Treasury Department was performed under the supervision of the Chief of Bureau. All analyses in connection with the cooperative experiments on sugar-producing plants (beets, sugar cane, and muskmelons) which have been conducted for several years in collaboration with various experiment stations are also made in the sugar laboratory. The total number of analyses reported was 1,744.

#### THE DAIRY LABORATORY.

Of the 1,056 analyses made in this laboratory, 807 were reported to the dairy division of the Bureau of Animal Industry, for which Bureau the chief of the laboratory served twice as a witness in a renovated butter case tried in New York State. The difficulty of distinguishing between butter produced by feeding cotton seed or cotton-seed meal and that to which foreign fats have been added, presented itself, and will receive special study during the coming year.

## THE CONTRACTS LABORATORY.

The work performed in this laboratory included a large part of that referred to under collaborative work, and consisted mainly in the examination of samples submitted with bids for contracts to different branches of the Government, and in the development of qualitative and quantitative methods for the analysis of the same. Especially exhaustive examinations were made of khaki cloth for the Navy Department and 60 samples of ink for the Post-Office Department, a set of methods being determined in the progress of the latter work which were published as Circular 12, Bureau of Chemistry. Sample inks, prepared according to recipes developed in the laboratory, were sent to the Post-Office Department to be tested, and a set of standards established whereby to judge of an unknown ink.

## THE ROAD-MATERIAL LABORATORY.

While the work of this laboratory has continued along the same general lines as in the past, its usefulness has been greatly extended, especially by the increase of its force.

The work of the chemist in charge included an investigation of the cause of the cementing power of rock dust, gravels, and clays, which involved many complete analyses and resulted satisfactorily. Other researches of immediate practical value have included a series of experiments on the burning and clinkering of clays, with a view to their use as road materials, and a study of the possibilities of increasing the binding power of materials by artificial means. During the coming year it is hoped that a thorough, practical test of burnt clays for country highways may be completed, as there are vast areas throughout our country where this is the only road material available, and the determination of the quality of clay adapted to this purpose would solve a great problem in road building.

Another important problem being studied in connection with such localities involves an elaborate series of experiments with mixtures of crude petroleum and asphaltum. The object of these experiments is to provide a binder surface for country roads which will place what would be practically an asphalt road within the reach of all rural districts, the cost of this mixture and its application being less than that of watering a macadam road.

Two new tests for determining the hardness and toughness of rock are to be adopted and reported on all routine samples, which it is believed will be of great assistance to road builders. These tests represent a new field of investigation and the machines for making them have been designed and are now in operation.

Other questions to receive special consideration are the testing of cement and concrete for road foundations, drains, and highway bridges,

and tests on paving brick. The general testing of rock for macadam roads will be continued.

A bulletin on the testing of road materials, giving a detailed account of the methods employed and the results obtained in this laboratory, is now in press.

#### THE DRUG LABORATORY.

This laboratory went into operation on March 1, 1903, and has already reported on 120 samples of drugs and chemicals. The work so far done on representative samples of drugs shows that some of these articles are of a very unsatisfactory character. A bulletin entitled *Adulterated Drugs and Chemicals* is about to be issued.

#### BUREAU OF SOILS.

##### PROGRESS AND COST OF THE SOIL SURVEY.

The work in which the Bureau of Soils is engaged forms an important link in the chain of duties devolving on the Department. It is fundamental in character, and as the survey and classification of the soil progresses the results are being more and more made use of by other offices of the Department, as well as by outside investigators and by our citizens.

Up to this time the distribution of the surveys has been influenced by the desire to gain as wide a knowledge as possible of the soils used in the most important agricultural industries of the country, and in this way the work has been scattered through all parts of the country. Thus studies have been made of Eastern and Western fruit districts, of sugar-beet lands, of the cotton and rice lands of the South, of the corn lands of the Central West, and the wheat lands of the Northwest and the Pacific coast, and of the soils of all the important tobacco districts.

One important purpose of the work is to provide data for the comparative study of more or less widely separated areas devoted to the cultivation of similar products, with a view to carrying the better practices of one area to the other, and of suggesting improvements in the methods used and changes in the kind of crops grown. It is one purpose of the work to show where old industries can be extended or new ones established, while the value of the reports and maps to those wishing to purchase lands for any specific purpose is too evident to need emphasis.

The statistics collected by the Bureau will be particularly important in the carrying on of immigration and colonization enterprises.

The area surveyed and mapped during the fiscal year was 23,293 square miles, or 14,907,520 acres, an area just about equal to the total area previously surveyed since the beginning of the work, four years ago.



This enlarged work has been accomplished in part by the organization of five new field parties on the 1st of March, made possible by increased appropriations by Congress, and partly by keeping the parties continuously in the field, moving to Southern areas in the winter. While considerable time was lost in some of the areas by reason of excessive rains, upon the whole this plan has worked well and has materially reduced the cost per square mile. The work has been carried on during the year in 63 areas in 34 States and Territories, as shown in the following tables:

*Areas surveyed and mapped during fiscal year ended June 30, 1903, and the areas previously reported.*

State or Territory.	Work dur- ing 1903.	Work previously reported.	Total.	
	<i>Sq. miles.</i>	<i>Sq. miles.</i>	<i>Sq. miles.</i>	<i>Acres.</i>
Alabama.....	1,223	.....	1,223	782,720
Arizona.....	108	503	611	391,040
Arkansas.....	251	.....	251	160,640
California.....	1,959	1,962	3,921	2,509,440
Colorado.....	1,195	150	1,345	860,800
Connecticut.....	273	245	518	331,520
Florida.....	548	.....	548	350,720
Georgia.....	186	571	757	484,480
Idaho.....	678	399	1,077	689,280
Illinois.....	2,241	1,356	3,592	2,298,880
Indiana.....	387	.....	387	247,680
Iowa.....	576	440	1,016	650,240
Kansas.....	.....	464	464	297,600
Kentucky.....	507	330	837	535,680
Louisiana.....	740	202	942	602,880
Maryland.....	487	2,147	2,634	1,685,760
Massachusetts.....	267	143	410	262,400
Michigan.....	30	828	858	549,120
Minnesota.....	233	.....	233	149,120
Mississippi.....	661	656	1,317	842,880
Missouri.....	751	168	919	588,160
Montana.....	.....	107	107	68,480
New Jersey.....	395	908	1,303	833,920
New Mexico.....	.....	129	129	82,560
New York.....	1,075	483	1,558	997,120
North Carolina.....	1,221	3,425	4,646	2,973,440
North Dakota.....	856	.....	856	547,840
Ohio.....	375	980	1,355	867,200
Oregon.....	386	.....	386	247,040
Pennsylvania.....	266	938	1,204	770,560
Porto Rico.....	.....	330	330	211,200
South Carolina.....	1,346	686	2,032	1,300,480
South Dakota.....	485	.....	485	310,400
Tennessee.....	.....	547	547	350,080
Texas.....	1,238	495	1,733	1,109,120
Utah.....	200	794	994	636,160
Virginia.....	1,143	1,604	2,747	1,758,080
Washington.....	51	459	510	326,400
Wisconsin.....	955	.....	955	611,200
Total.....	23,293	22,445	45,738	29,272,320

*Cost of survey.*

Cost of field work .....	\$51, 136. 60
Supplies .....	1, 901. 59
Traveling expenses between areas .....	5, 215. 76
Other expenses .....	5, 059. 56
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Total cost of soil survey .....	63, 313. 51
Paid by State organizations .....	1, 748. 35
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Paid by Department of Agriculture .....	61, 565. 16
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Area surveyed.....square miles..	23, 299
Cost of work in field per square mile .....	\$2. 19
Transportation, supplies, and other expenses per square mile.....	\$0. 52
Total cost per square mile.....	\$2. 71
Cost to Department of Agriculture per square mile.....	\$2. 63

The cost of work in the field has increased from \$1.83 per square mile, as reported last year, to \$2.19 per square mile. This is due in part to increased salaries, necessitated by the fuller experience of the principal assistants, and in part to a large amount of rainy weather in the winter, which raised the cost in some of the Southern areas very considerably above the average.

On the other hand, the advantage of keeping the men out, in spite of the delays from the winter rains, is seen in the reduced cost per square mile where all expenses chargeable to the soil-survey work are included. Last year the average cost to the Department of Agriculture was \$2.81 per square mile, and this year the total cost is \$2.63 per square mile. It is probable that this is the lowest cost that can be reached, and from now on the cost may gradually increase somewhat, owing to the increased salaries which it may be necessary to pay to hold experienced men in the service.

There has been a great demand for our men from colleges and experiment stations and in private enterprises, but it has been the desire of the Department to keep the men at least five years in the soil survey, after which it is believed they will have had as much experience as they can get from such service, and they should then be prepared to take up special lines of investigation, or be ready to enter into positions of responsibility in educational institutions where soil investigations are being built up.

Although a total of \$61,565.16 was spent by the Department for the soil-survey work and \$1,748.35 by State organizations cooperating, and 63 areas were surveyed and mapped, with an average of 369 square miles each, we were unable to reach more than half of the areas in which surveys have been requested, and we have on file requests for nearly two years' work with the number of parties available with our present appropriations.

## PUBLICATION OF THE REPORT ON FIELD OPERATIONS.

In my last report I called attention to the urgent need—if the full benefit of the soil-survey work is to be secured—of a change in the manner of publishing and distributing the reports on the soil surveys. As the law now stands, in the joint resolution approved February 23, 1901, the manuscript of these reports has to be submitted to the Public Printer all at one time, and the reports must be issued as one volume, with the maps in an accompanying portfolio. The Senate and House of Representatives together have 9,000 copies and the Department has 8,000 copies for distribution. This gives each Representative about 16 and each Senator about 32 copies—about enough for the public libraries and institutions in their respective States. In addition the Department has usually ordered from 500 to 1,000 reprints of the report on each separate area, and has distributed these as far as they would go in the districts to which the work pertains. Besides being entirely inadequate to fill Congressional needs, this manner of publication has the disadvantage of not enabling the Department to meet the local demands.

One of the chief values of this work lies in the suggestions it affords to the owners of land in the area in directing their attention to new crops and to better methods of agriculture. The bound copies that go to libraries, public institutions, and prominent citizens are very good as works of reference; but for the utmost good to come of the soil survey, copies of the separate reports and soil maps should be placed in the hands of a considerable number of people within the area surveyed, and our experience in the past has shown that there are from 500 to several thousand requests of this kind that the Department has not been able to meet. I would therefore recommend to Congress that, in addition to the bound volumes already authorized, there be printed in the form of advance sheets, as soon as the manuscript, maps, and illustrations can be prepared, a separate report on each area surveyed as completed, of which 500 copies shall be for the use of each Senator from the State, 2,000 copies for the use of the Representative for the Congressional district in which the survey lies, and 1,000 copies for the use of the Department of Agriculture. The reports could in this way be sent out from six to twelve months earlier than is now possible, and could be distributed while the matter is still fresh in the minds of the people who have watched the progress of the field work. It would also be practicable in this way to supply the local demand, a thing quite impossible under the present plan.

## ALKALI RECLAMATION.

During the past year the Bureau of Soils has been engaged in making alkali reclamation demonstrations in several parts of the arid

West. One such experiment is located near Salt Lake City, Utah, where there is an area of about 120 square miles (75,000 acres) of land unproductive because of excess of alkali. A tract of 40 acres, typical of this waste land, was secured in the summer of 1902 for the purpose of experiment, and the work of reclamation, which is being done in cooperation with the Utah Experiment Station and the owner of the land, has progressed rapidly and satisfactorily.

At the time of beginning the work on this tract it contained a little more than  $2\frac{1}{2}$  per cent of salt, or a total of 6,650 tons of salt in the soil to a depth of 4 feet. At the present time there has been removed from this tract, by the simple method of underdrainage and flooding, two-thirds of this quantity.

The following table gives the quantity of water added to the 40-acre tract and the amount of salt added in the irrigation water. The period covered extends from September 1, 1902, to September 1, 1903.

*Total quantity of water used in flooding and amount of salt added from this source in the experiment at Salt Lake.*

Date.	Water added.	Source of water.	Salt added.
1902.	<i>Cubic feet.</i>		<i>Pounds.</i>
September.....	284,400	Canal.....	24,000
October.....	940,000	....do....	83,900
November.....	171,300	Rain.....	
December.....	166,500	....do....	
1903.			
January.....	291,800	Rain.....	
February.....	136,400	....do....	
March.....	132,000	....do....	
April.....	112,000	....do....	
May.....	576,900	....do....	79,000
Do.....	760,900	Canal.....	
June.....	106,000	Rain.....	70,700
Do.....	676,500	Canal.....	
July.....	36,588	Rain.....	169,190
Do.....	1,691,966	Canal.....	
August.....	2,122,157	....do....	212,000
Total.....	8,305,411		638,790



The following table shows the drainage from the tract from September 1, 1902, to September 1, 1903, and the quantity of salt removed in the drainage water during that period:

*Total quantity of water carried off through the drains and the quantity of salt removed in this way in the experiment at Salt Lake.*

Date.	Drainage.	Salt removed.
1902.	<i>Cubic feet.</i>	<i>Pounds.</i>
September .....	158,700	152,200
October .....	265,000	195,100
November .....	251,000	353,800
December .....	139,700	187,600
1903.		
January .....	257,300	391,200
February .....	174,400	214,800
March .....	428,000	590,700
April .....	26,900	26,500
May .....	521,500	567,100
June .....	274,500	345,200
July .....	480,490	556,459
August .....	814,890	1,221,742
Total .....	3,792,380	4,802,601

From the foregoing tables it will be seen that there has been added to the Swan tract 8,305,411 cubic feet of water, equivalent to 57 inches in depth over the entire tract, and of this quantity 3,792,380 cubic feet, or 45 per cent, was recovered in the drainage. This drainage water, equivalent to 26.2 inches in depth over the entire tract, carried 2,401 tons of salt. Should we consider the seepage water which has drained into the subsoil and not out through the drainage tile, it is likely that at least 4,000 tons of salt have been eliminated from the land.

Seventy-five per cent of the area of the tract at Salt Lake contained less than 0.40 per cent of alkali in the first foot of soil as against  $2\frac{1}{2}$  per cent one year ago, and the entire area, it is believed, will be sufficiently sweetened by the end of the present season to permit the growing of a shallow-rooted crop. It will be seen from this that the ultimate complete reclamation of the land seems assured, and the Department believes that the object lesson thus afforded the farmers of this and other arid regions will stimulate them to take up the work of reclaiming these waste but fertile lands.

The value of the alkali lands at Salt Lake City is only \$8 an acre, while lands not affected by alkali bring from \$100 to \$350 an acre. The cost of installing the drainage system was about \$16 an acre, so that even with the additional cost of the irrigation water the margin of profit in the reclamation of these lands is wide enough to interest capital.

Besides the work at Salt Lake City, a tract of 20 acres near Fresno,

Cal.—where lands have depreciated not less than \$1,000,000 in value in the last few years on account of the rise of alkali—was taken under lease for reclamation. This land was at one time sold for \$350 an acre, but had become badly alkaline, and was abandoned and of merely nominal value at the time of undertaking its reclamation. The work at Fresno has been quite as successful as at Salt Lake City, and at the end of four and a half months the greater part of the 20 acres was in condition to permit the planting of alfalfa, which crop will be seeded as soon as the proper season arrives.

The cost of installing the drains at Fresno was \$15 an acre, but at Yakima, Wash., where a third experiment is under way, the cost was \$21 an acre, a difference due mainly to the higher price for drain tile. The system at Yakima has also been successfully installed, and land, worthless for agricultural purposes at the inception of the experiment, will, it is believed, be in as productive a condition at the end of two years as contiguous lands now valued at \$150 an acre.

It is the purpose of the Department to establish six of these demonstration experiments in parts of the West where there has been great loss from the rise of alkali. The need for such object lessons has been forcibly impressed upon the Department by the apathy of the communities where the alkali evil exists and increases. The people seem to stand in awe of alkali and to doubt that they can cope with it, notwithstanding the insistent teachings of experts to the contrary. This is not the case in Egypt, where vast areas of land more salty than any but the very worst soils in the Colorado Desert have been reclaimed by practically the same methods as those recommended by the Department and now successfully in use in these experiments. And these demonstrations have been undertaken in the belief that when the people see that the rise of alkali can be prevented, or that where alkali has accumulated it can be economically removed, they will take the matter into their own hands and either privately or cooperatively set about the systematic protection and reclamation of these very valuable western lands.

#### TOBACCO INVESTIGATIONS.

Some supervisory work was done in Connecticut during the past fiscal year, but the large purpose of the Department, which was to show the Connecticut tobacco growers that a wrapper leaf of superior quality could be produced on a specific soil type established in the soil survey of the Connecticut Valley, has been successfully brought to a close. It remains now for the growers to put the shade-grown Sumatra industry on a substantial basis, toward which condition great progress has already been made.

The investigation of the fermentation of Ohio tobacco has also been continued, and the interest in bulk fermentation, which is far better

than the case method up to this time largely employed by the packers, is gaining ground.

The quantity of tobacco handled according to the method prescribed by the Bureau of Soils has increased from 655,200 pounds of the 1901 crop to 4,204,800 pounds of the crop of 1902. This tobacco is Zimmer Spanish and Little Dutch, varieties used in the manufacture of cigars, and the substitution of the bulk method of fermentation for the present practice of case fermentation will not only prevent great loss from rot and imperfect curing, but will also result in a general improvement in the several grades of this tobacco, and thus greatly increase the profits of the grower and packer.

By far the most important work of the Bureau of Soils during the past year, under the authorization for tobacco investigations, has been the experimental growing of Cuban cigar-leaf tobacco on certain soils in South Carolina, Alabama, and Texas. These soils, the Orangeburg sandy loam and the Orangeburg loam, are apparently very similar to the tobacco soils of Cuba, and the aroma of the leaf grown on one of these soils in Texas has been pronounced by the trade to be very fine. The crops grown on the experimental plots are now in course of fermentation, and it is too early to state definitely what the outcome will be, but so far as is now known the quality of the leaf will be excellent.

As these experiments in the South look toward the establishment of a new tobacco industry in that part of the country and to the production of a leaf to compete with the Cuban grown tobacco, a comparative statement of the production and value of the domestic leaf and the imports and value of the Cuban tobacco is appended.

*Production and value of filler tobacco in 1901.*

Type.	Production.	Value.
	<i>Pounds.</i>	
Ohio.....	35,654,314	\$3,832,839
Pennsylvania.....	17,614,380	2,113,725
Other domestic filler.....	17,666,531	1,971,584
Total domestic filler.....	70,935,225	7,918,148
Imported Cuban, 1901.....	18,554,775	16,212,773

In the above table the production of the domestic tobacco is on the basis of the fermented leaf, 20 per cent having been deducted from the total production for shrinkage in fermentation and loss in handling. In the case of Ohio the necessary allowance for other types than the filler types grown in the State has been made. Two cents per pound has been added to the value of the domestic tobacco to provide for the expense of fermentation, etc., thus putting the Cuban imports and domestic filler on the same basis. It will be seen from these figures

that the Cuban imports, while only one-fourth as great in quantity, represent two and one-third times the value of the domestic product.

It is the purpose of the Department, if the results of this year's work warrant, to carry on the filler experiments in the South on broader lines; similar to those of the Sumatra experiments in Connecticut, and then to extend its operations into other States where the results of the soil survey show that tobacco can be raised or where improvements can be made.

#### WORK OF THE SOIL LABORATORIES.

Besides routine work the laboratories of the Bureau of Soils have been developing several special investigations in the physics and chemistry of soils. Much of their work is of a purely technical character, necessary to a proper understanding and handling of the large soil problems which the Bureau is investigating, but not in itself of immediate interest or value to the practical agriculturist. Some of the work, however, has an immediate interest and is of a far-reaching and fundamental character.

The subject of most practical importance to the farmers of the country is the yield of crops, which has been popularly believed to be more or less directly influenced and controlled by the chemical characteristics of the soil. The Bureau has therefore made an exhaustive research, the results of which modify very materially the current conceptions of this matter. In considering the question the aim was to determine what amount and proportion of the several mineral plant foods were actually in solution in the soil at any one time, or from time to time; since it has been admitted by practically all authorities that it is the solution naturally existing in soils which is the immediate source of the mineral foods obtained by the crops growing upon them. Birner and Lucanus, as long ago as 1866, pointed out that plants can be grown to perfection in well water if suitable physical conditions are preserved, and, as a matter of fact, they grew oat plants in such water, renewed weekly, the yield of grain being double that from a rich garden soil.

Until the work was undertaken in this Department it had never been possible to make a satisfactory study of this subject, owing to the difficulties encountered in isolating the natural nutrient solution from the solid soil and in analyzing this solution for the extremely small amounts of dissolved material maintained in it.

By careful work and unusual ingenuity these analytical difficulties have been surmounted by the Bureau and methods devised that enable us to obtain the soil solution and to estimate, with a degree of accuracy little short of marvelous, the amounts of the constituents contained which are of significance for plant growth. Moreover, by means of portable outfits it has been possible to make these determinations in



the field, where local conditions can be studied in conjunction with the analysis of fresh soil samples.

The chief of the Bureau, Professor Whitney, concludes, from the consideration of some hundreds of examinations with these new and exceedingly delicate methods, that there is no apparent relation between the dissolved salts of the soils, as determined by the methods, and the yield of crops, and that there are no constant differences between the different types of soil, although these types differ widely in their agricultural values. With such small differences as were actually found, quite as often the larger amount of plant food was found associated with a poorer crop, and vice versa; and, furthermore, the chemical differences between soils of various types with known wide variations in agricultural value, or between soils of the same type supporting on the one hand good, on the other poor crops, were no larger than those found between soils yielding approximately equal crops.

He argues, therefore, that nearly all soils are amply supplied with the necessary mineral plant food, and that these plant foods are not in themselves a matter of paramount importance to the agriculturist, for their supply as regards the plant is determined by the supply of soil moisture which the crop can obtain from the soil; that the chemical analysis of a soil can not in itself, therefore, throw much light upon the problem of fertility, but when the farmer attempts to control the factors governing crop yield his attention must be directed to the mechanical condition of the soil as affecting the supply of soil moisture with its dissolved mineral nutrient, to the effects of climate, to rotation, and to general soil management. These matters have all been fully treated in a recent publication (Bulletin No. 22) of the Bureau of Soils.

## BUREAU OF STATISTICS.

### WORK OF THE YEAR.

The work of the Bureau of Statistics has been continued on the usual lines. In addition to the regular work in estimating crop conditions, etc., statistical matter relating to the principal crops and farm animals, freight rates, exports, etc., in the United States and foreign countries has been prepared for publication, and numerous inquiries from various interested parties as well as Bureaus and Divisions of this Department have been answered, all of which has necessitated a vast amount of research and compilation.

Several special reports have been published during the year. These reports include a statistical description of the "Wheat Ports of the Pacific Coast," "Practices in Crop Rotation," "Flaxseed Production," "Commerce and Manufacture in the United States," "Milk Transportation: Freight Rates to the Largest Fifteen Cities in the United

States," and "Relations of Population and Food Products in the United States."

#### FOREIGN AGRICULTURAL STATISTICS.

The statistical expert who has for some years had charge of the crop statistics of foreign countries competing with the United States has been stationed during the year in London, England, where he has been in closer touch with the statistical offices of the different European governments, whose reports, along with the most authoritative commercial intelligence of interest to American agriculturists, he transmits to Washington by mail or cable from time to time. Negotiations with the governments of various important grain-producing countries of Europe, and also with that of the Dominion of Canada, looking to a telegraphic interchange of crop reports similar to that already in operation between the United States and Hungary have been continued, and it is not improper to state that these negotiations have now reached such a stage that there are good grounds for believing that the growing season of another year will see the American farmer placed in as prompt possession of trustworthy statistics concerning the principal grain crops of foreign countries as he is of those of the United States.

#### COOPERATION WITH OTHER BUREAUS AND DIVISIONS.

During the year there has been cordial cooperation between the Bureau of Statistics and the Bureau of Plant Industry, the Bureau of Animal Industry, the Bureau of Forestry, and the Bureau of Soils, with such satisfactory results as to assure even greater cooperation and mutual dependence in the future than in the past. Throughout the whole of the research work of the Department the best results have been obtained by the cooperation of one set of specialists with another. The statistical work contained in the various publications of the different branches of the Department of Agriculture is largely done by employees of the Bureau of Statistics, and such statistical work as is not done in that Bureau is carefully revised by the Statistician and receives his approval before being published as the work of any other Division or Bureau of the Department.

#### COST OF CROP PRODUCTION.

In cooperation with the State Agricultural College of Minnesota, an investigation is being conducted by the Division of Statistics to determine the cost of production per acre of the principal crops. Although this work is not sufficiently complete to permit of publication of results at the present time, these data, when properly tabulated and analyzed, will undoubtedly be of great value in solving questions of farm management, and various other problems that confront the modern farmer.

## THE STATISTICAL LIBRARY.

While there is no branch of statistics having a close relation to the agricultural industry that is not more or less adequately represented in the Department's statistical library, as regards the literature of prices, it is believed to be the best equipped library in the country, and no reasonable expenditure that may be necessary to maintain its present high standing should be withheld. Its card index to agricultural statistics is exceptionally complete and well arranged and has proved of great value to visitors who have had occasion to consult it.

## BUREAU ORGANIZATION.

On July 1, 1903, the Division of Statistics became a bureau, and the Division of Foreign Markets was placed under the direction of the Statistician. Both the clerical and field forces will now be materially strengthened, and, while the work must necessarily be continued along practically the same lines as heretofore, no effort will be spared to strengthen and improve the reports on the staple crops and give more detailed information with regard to fruits and various minor crops. Until the present year it was found impossible to make quantitative estimates of any but the principal crops, but flax was added during the year, and the necessity for extending this work to embrace other products—such as rice, sugar, fruits, etc.—is every day being more forcibly brought to the attention of the Department. With a moderate addition to the field force the organization for collecting data will be sufficiently well organized to enable the Statistician to include details of all minor crops and of fruits in his monthly reports. But to successfully extend the work to embrace these crops it will be necessary to strengthen the office force by the appointment of a sufficient number of computers to collate and analyze the reports sent in by correspondents and field agents.

The organization of the field force has already been carried to a very high state of efficiency, and it is proposed materially to increase this efficiency by the appointment of additional field agents so soon as the bureau organization becomes effective.

It is my desire to so strengthen this Bureau as to enable it to become, as I conceive it should be, the principal source of reliable information on the agricultural resources of the country.

## FOREIGN MARKETS.

## COMPREHENSIVE INVESTIGATIONS.

Special comprehensive investigations involving much labor in the collection of statistics and in table building have engaged the efforts of the Division of Foreign Markets during the fiscal year. These investigations bring together vast amounts of information concerning the trade of this and other countries in exporting and importing farm

and forest products which has not hitherto been in form readily available to the general public.

#### TARIFFS OF FOREIGN COUNTRIES.

On account of the numerous changes in the tariff laws of many important countries, frequent inquiries are referred to this Division for information regarding tariff rates and customs regulations of certain agricultural products in foreign countries.

In order to supply this information in condensed form, the Bureau has been charged with the publication of a series of bulletins giving, in English, the import duties on certain important groups of agricultural products that are levied in foreign countries.

The greatest care has been exercised to make this information accurate, and no efforts have been spared to get the most recent information from each country.

The countries, including their colonies and dependencies, for which these tariff schedules have been compiled, number 162, which includes, for the sake of completeness, the tariff of the United States and that of the Philippine Islands.

#### FIFTY YEARS OF EXPORTS.

The numerous demands for information as to export statistics of farm products from the United States, covering a period of years longer than the ten-year statements customarily made by this Division, have suggested the compilation of tables showing these exports for a long period of years, beginning with 1851. From these tables are derived the figures on our exports of farm products given in the earlier portion of the present report.

These figures exhibit a steady and regular increase in the volume of our agricultural export trade, in which cotton, grain and grain products, and meat and meat products were the principal factors. Other important items were live animals and tobacco. The five items mentioned have formed the bulk of our agricultural export shipments throughout the period 1851-1902, with the exception of the years 1861-1865 when, on account of the civil war, our exports of cotton were almost entirely suspended.

#### GERMAN IMPORTS OF FARM PRODUCTS.

The imports of farm products into the German Empire were made a special subject of inquiry by the Division of Foreign Markets, and resulted in a full analysis of products by kind and by country of origin.

Farm products constitute a much larger percentage of the imports of the German Empire than they do in this country, the percentage



for Germany being 59.2 for the five years 1897-1901. The average annual value of the farm products imported from 1897 to 1901 was \$745,198,480; the amount for 1901 was \$790,564,700, of which amount the United States supplied 21.9 per cent. Of the imports of agricultural raw materials, the United States supplied 20.5 per cent; food products, 21.7 per cent; feed stuffs, 37.3 per cent; miscellaneous farm products, 3 per cent.

As contributors to the imports of farm products into Germany the various countries rank in order as follows, with the percentage of imports derived from each: United States, 21.9 per cent; Russia, excluding Finland, 16.3 per cent; Austria-Hungary, 10.6 per cent; British East Indies, 5.6 per cent; Argentina, 5.4 per cent; Italy, 4.4 per cent; France, 4.4 per cent; the Netherlands, 4 per cent; Brazil, 3.2 per cent; Belgium, 2.8 per cent; United Kingdom, 2.7 per cent; Dutch East Indies, 2.4 per cent; British Australasia, 2.4 per cent; Denmark, 1.6 per cent; Switzerland, 1.6 per cent; Roumania, 1.3 per cent. No other foreign country has a percentage as high as 1.

#### TRADE IN FOREST PRODUCTS.

This subject, which had hitherto received scant attention, has been made a prominent subject of investigation during the year just closed, and will hereafter receive the attention of this Division in conjunction with the subject of trade in farm products.

While it is true that in the immense aggregate of our foreign trade forest products occupy a small place relatively, yet, expressed in value, this trade has grown to large proportions, the growth being more especially manifest in exports than in imports. The domestic exports of forest products in 1893 amounted to \$28,127,281, and during the five years 1893-1897 the annual average was \$31,782,928. During the following five years, 1898-1902, the annual average grew to \$47,648,530, the highest amount for one year being \$55,369,161 for 1901. This average was considerably exceeded in 1903, when the amount was \$58,281,124. During the eleven years the value of the domestic exports of forest products was about 3 to 4 per cent of the total domestic exports.

During the five years 1893-1897 the annual average value of the imports of forest products was \$44,638,795, an amount from which the imports for each year did not vary much. In the following five years the annual average increased about \$10,000,000, making the average for 1898-1902 \$55,205,996; the highest amount for one year was \$60,633,078, in 1900. In 1903 the value of the imports of forest products rose to the highest figure yet attained, \$71,478,022. The relation between the value of the imports of forest products and the total imports is expressed by 5.9 per cent for the five years 1893-97,

being 7.1 per cent for the five years 1898-1902 and 7 per cent for the year 1903.

The imports of forest products are constituted chiefly of various gums, india rubber, cork, dyewoods and their extracts, and cabinet woods; also timber, lumber, and wood pulp, principally from Canada. It appears, then, that the principal portion of these imports is of materials that do not grow in this country or, if growing here, are not produced in sufficient quantities for the demands of consumption, as in the case of timber, lumber, and wood pulp.

The imports of agricultural products for 1903 amounted to \$456,199,-325, a higher amount than for any preceding year and \$36,060,037 greater than for 1900. Of the total imports, 44.5 per cent are classified as belonging to farm products. This percentage shows a decline; for the five years 1893-1897 it was 51.5 per cent and for the five years 1898-1902 it was 48.7 per cent.

Farm products have declined as an element of domestic exports also during the last eleven years, although no decline is perceptible during the last five years. In 1903, 63.1 per cent of the total domestic exports was composed of farm products.

Upon combining the domestic exports of forest products with those of farm products, the total constitutes 67.3 per cent of all domestic exports for 1903. The percentage for the preceding five years was 68.8. The value of the farm and forest products exported for 1903 was \$936,760,575, compared with which is the annual average of the preceding five years, \$908,686,344, and the average of the five years 1893-1897, \$647,857,875.

These two classes of products constituted 51.4 per cent of the imports of 1903, the percentage for the preceding five years being 55.8 and for the five years 1893-1897, 57.1. In value the imports of these two classes of products in 1903 amounted to \$527,677,347, in comparison with which are the annual average of the five preceding years, \$434,331,088 and the annual average of the five years 1893-1897, \$33,805,721.

## DIVISION OF ENTOMOLOGY.

### WORK ON INSECTS FROM ABROAD.

#### THE ASIATIC LADYBIRD ENEMY OF THE SAN JOSE SCALE.

In the report of last year a rather full statement was made concerning the importation of a ladybird enemy of the San Jose scale, found in China and Japan by the first assistant entomologist. During the late summer of 1902 eight colonies of this beetle were distributed in six States. In the experimental orchard of the Division of Entomology the insect wintered well out of doors, and started breeding early the present season. The colonies distributed

during that summer were mainly put in charge of entomologists of State experiment stations. During the early summer of 1903 some 26 colonies were distributed in Maryland, North Carolina, Georgia, Alabama, Delaware, New Jersey, New York, Ohio, Oregon, Tennessee, Virginia, and West Virginia.

Of last year's distributions, those sent to Georgia have given the best promise. One of these established in a large orchard of 17,000 peach trees, with a contiguous orchard containing 250,000 trees, both orchards infested with scale, shows the most satisfactory results. By the 1st of July, 1903, the ladybird had spread through the original orchard of 17,000 trees and then occurred to the number of thirty or forty thousand. Three additional broods are expected during the season, and these numbers should be vastly augmented. Colonies have been distributed from this orchard to various parts of Georgia.

The experiences of the year have, therefore, been very encouraging. Every effort will be made to distribute this beetle throughout the regions where the San Jose scale occurs. The work, however, is still in the experimental stage, and too great hopes should not be aroused. Recommendations for the prompt application of sprays and other remedial treatment should not be neglected.

#### OTHER BENEFICIAL INSECTS.

The fig fertilizing insect continues to be a great success in California. Large crops of figs were raised at Fresno, and the quality seems to have been even better than during the previous year. A number of new orchards of Smyrna and capri-figs have been started, and there is no doubt that the insect has been thoroughly acclimatized at Fresno and at Niles.

One of the most striking of the recent beneficial results of these introductions has been the good work done by the parasitic enemy of the black scale (*Scutellista cyanea*) which was originally imported by the Division of Entomology from Italy and later from South Africa, and established in the orange and olive groves of California. The best work has been done in the southern part of the State, where the insect has been established in every county south of Point Conception. It is very plentiful in Los Angeles, Orange, and San Diego counties, and is still being sent out from the office of the First Deputy Commissioner of Horticulture at San Francisco. The Los Angeles commissioners distributed over 400 strong colonies at Escondido. At Pasadena the insects have spread naturally, and in the colonization districts over 90 per cent of the black scale has been destroyed by the parasite, which is still breeding.



## WORK ON THE COTTON BOLL-WEEVIL.

The continued spread of the cotton boll-weevil, and the danger threatening the most important industry of the South by the direct prospect that it will soon reach all portions of the cotton belt, resulted in the appropriation by Congress of \$20,000 for a continuation and enlargement of the work of the Division with that pest. This work was under the direct charge in Texas of Mr. W. D. Hunter, who was aided by a number of assistants.

The funds at the disposal of the Division enabled it for the first time to conduct experiments with the cultural methods of controlling the pest on a large scale. This was accomplished by entering into contract with two representative large planters in typical situations in Texas. By the terms of these contracts the planters agreed to plant, cultivate, care for, and in every way manage the crop exactly in accordance with the directions of the agent in charge. In this manner the Division was given practically complete charge of 325 acres, but without the trouble and expense of renting the land and working the crop. These experiments were located at Calvert, in the Brazos Valley, the most seriously infested portion of the territory at present, and at Victoria, in the extreme southern portion of the State, where the existence of volunteer cotton furnishes the weevils with food very early in the season, thus adding an important feature to the problem that does not occur elsewhere.

At Victoria a field laboratory was fitted up, where a thorough study was made of every feature of the life history of the weevil. The matter of parasites and the possibility of controlling the pest by their artificial propagation, which has always appealed strongly to many planters, received especial attention. In pursuance of this feature of the investigation the agent in charge made a trip to Mexico, where the governmental commission that had been created for the study of the weevil problem has especially concerned itself with the propagation of a mite (*Pediculoides ventricosus*), which, at least under certain conditions, has been found to destroy the larvæ of the pest. The agent made a study of the methods pursued in the laboratory of the commission at Cuernavaca, and through the courtesy of Prof. A. L. Herrera, the head of the commission, he was enabled to bring back to Texas a large number of cultures. These parasites were distributed from the laboratory at Victoria. The work is being continued this season, but the indications are that climatic conditions will always render unobtainable in Texas whatever useful results may have been obtained in Mexico.

## WORK ON INSECTS DAMAGING FORESTS.)

With the beginning of the fiscal year a section of the Division of Entomology was organized for the investigation of insects injurious



to forests. Dr. A. D. Hopkins was put in charge of this work, and during the year three assistants were assigned to him. The work was carried on in cooperation with the Bureau of Forestry, and investigations have been made in nearly all of the States and Territories. Depredations by a bark beetle on the Silver Pine, Red Fir, and Lodgepole Pine in the Priest River Forest Reserve in Idaho, and by an important wood-boring enemy of the Red Fir near the Olympic Forest Reserve in Washington, were investigated.

An important result of the work of the year was the determination that the destruction of many large areas of timber, which was supposed to be the result of forest fires, was primarily the work of insects, the insects having killed the timber, which then offered favorable conditions for the starting of extensive fires. A serious trouble affecting the pines in the Rocky Mountain region from Arizona to Idaho, caused by bark beetles and which resulted in the death of a vast amount of timber in the national reserves and on public and private lands, was also investigated.

Many other similar investigations were carried on, and the most encouraging progress was made in the attainment of the principal object of the work, namely, the discovery and practical application of methods of preventing losses from the ravages of forest insects. The recommendations for checking the rapid spread of pine-destroying beetles in the Black Hills were adopted by the General Land Office of the Department of the Interior with good results, as were also recommendations for the control of the serious insect trouble affecting the pine timber on some 200,000 acres of forest and ranch land in north-eastern New Mexico.

Three field stations were established, one in the Black Hills, one at Tryon, N. C., and one at Hoquiam, Wash.

#### WORK ON THE CODLING MOTH IN THE NORTHWEST.

This work, which has been referred to in previous reports, was completed during the autumn of 1902. The special agent in charge during the following winter completed a full report on the investigation, which indicates very satisfactory results. Demonstration on a large scale of the efficacy of the measures adopted and recommended showed to the satisfaction of all concerned that the economical control of the codling moth in the Northwest is possible. It was conclusively shown that in the infested regions of the far Northwest from 85 to 100 per cent of the fruit was injured if no remedial measure was used, but that on intelligent application of the remedies advised by the Division of Entomology from 85 to 98 per cent of the fruit might be saved.

#### OTHER INVESTIGATIONS.

The work upon injurious scale insects has been carried on through the year. The methods of controlling the San Jose scale have become

more effective, and the advice issued by the Division of Entomology is embodied in two recently published and revised circulars giving the latest methods of control. Much work was done in the determination of scale insects for experiment stations and individuals, including the study of considerable material received from foreign sources, and especially from our new possessions, Porto Rico and Hawaii.

The investigations of insects injurious to truck crops have been carried on, and a special study has been made of those forms which injure the sugar beet.

The work on insects injurious to stored products has also been measurably successful, and the remedies proposed for this class of insects have been successfully tried by many individuals. An especial study has been made of the injuries of the so-called powder-post beetles to the wood used in making agricultural tools and furniture.

The insects affecting ornamental plants have also been studied to advantage.

The investigations of insects in their direct relations to the health of man, which have been under way for two years past, have been continued. Careful studies have been made of the habits and geographical distribution of the mosquitoes which convey malaria and those which convey yellow fever. An extensive investigation of the insects attacking the stems of growing wheat, rye, barley, and oats, not, however, including the Hessian fly which was earlier dealt with, has been completed during the year, and a final report prepared for publication.

The insects which affect mushrooms, the gadflies or horseflies, the insects which affect the seed of the clover plant, and the insects which affect the cranberry have been studied during the year and are being written up.

The work on insects affecting shade trees, which has been carried on now for several years, has been continued, and the preparation of an extensive bulletin on this subject is under way.

#### WORK IN SILK CULTURE.

An appropriation of \$10,000 to the Department of Agriculture for investigations in silk culture was made by Congress for the fiscal year 1903. The conduct of this investigation was placed in the hands of the Entomologist. Previous work by the Department in the years 1882 to 1891 had already demonstrated the possibility of raising excellent cocoons of the domestic silkworm in all parts of the United States in which the White Mulberry tree will grow. Therefore, in the investigations to be undertaken at this time, the whole attention of those in charge is naturally devoted to the main practical aspects of establishing the industry. Undoubtedly the first steps are to create a general interest in the subject, to insure the supply of leaves for

food for the worms, and to educate as many persons as possible in the care of the worms, so that a crop of cocoons will be assured to any individual or company desiring to go into the reeling business. The Entomologist, during the summer of 1902, visited the silk-growing regions of Europe and investigated the establishments for the selection of pure eggs and also investigated the communities in which silk culture has its strongest hold. He also contracted for the purchase of two four-basin reels. Considerable quantities of silkworm eggs of the best races were purchased, and mulberry seeds and cuttings of the best varieties were also contracted for.

During the winter and early spring eggs were sent in small quantities to all applicants who were able to assure the Department that they had at hand a proper supply of food for the worms. To those who had no food mulberry cuttings were sent. A small crop of cocoons was raised at the Department in the spring of 1903. Nearly all of the persons to whom eggs were sent reported that they had been able to rear the worms and produce the cocoons without great difficulty, and letters were sent informing the raisers that their cocoons would be purchased by the Department at the current European market rates. One of the reels imported from Europe was put in operation at the Department of Agriculture, in Washington. Two expert reelers were secured from France, and at the close of the fiscal year reeling operations were about to begin. The second of the four-basin reels was loaned to The Seri-Culture and Manufacturing Company, at Tallulah Falls, Ga., where extensive planting of mulberry trees has been carried out and where experimental work is promised.

The establishment of the silk industry in the United States must be a matter of extremely slow accomplishment. Small appropriations by the General Government will assist in the education of an increasing class of silk raisers. The lack of a market for cocoons is the great difficulty at the present time. The limited market created by the Department out of this small appropriation is in reality an artificial one. It is necessary, however, to induce people to continue their interest in the subject and to educate a class of silk raisers, and for the present this method will be continued.

#### APICULTURAL INVESTIGATIONS.

The correspondence in relation to apicultural matters has been constantly increasing, and has covered a wider range of subjects.

In the autumn of 1902 a trip was made by the apicultural investigator through Nebraska and Colorado for the purpose of investigating certain conditions, especially in Colorado, regarding natural and artificial bee pasturage and the early breeding up of colonies of bees to enable bee keepers to take full advantage of the first crop of alfalfa. The recommendations made to cultivate early pollen-bearing crops.



such as Russian hairy vetch, and to employ more prolific, hardy, and strong-winged bees than Italians, such as the Carniolan and Cyprian races and their crosses, have, wherever followed, resulted in a marked increase in the honey yield and in earliness and size of swarms.

A number of queens of select breeding have been sent this year, as in the past, to experiment stations engaged in apiarian investigations, and for testing in sections where it seemed advisable to try certain breeds or crosses.

A race of bees little known in this country, the Caucasian, native to the southeastern provinces of Russia, bordering on the Black and Caspian seas, has been under observation. It promises to be a valuable addition to the varieties already bred in this country. The workers are good honey gatherers and most remarkably gentle. The queens are quite prolific. The exact status of the race as regards hardiness has not yet been determined, although in Colorado they have not seemed inferior in wintering qualities to the Italians already there.

#### EXPERIMENTAL WORK WITH INSECTICIDES.

The value of the standard insecticides, both for biting and sucking insects, including food poisons and substances which kill by contact merely, has been established by many years of experiment, but nevertheless, by the practical work of the Division of Entomology, such standard insecticides receive each year the indorsement of additional satisfactory experience. This applies not only to the control of insect enemies of field and garden crops and fruits, but also to house pests, as illustrated by additional practical work done during the year with the hydrocyanic acid gas treatment of houses described in the last annual report. The experimentation with petroleum oils, referred to in the former report, has been started during the present year in conjunction with the Bureaus of Plant Industry and Chemistry of this Department. This work, it will be recalled, was undertaken in response to special requests from the Society for the Promotion of Agricultural Science and from the Association of Economic Entomologists.

#### BIOLOGICAL SURVEY.

The Biological Survey is engaged in three distinct lines of investigation, each of which is as important and independent as the usual work assigned to a division of the Department. These lines consist of (1) the mapping of the boundaries of natural life and crop zones of the country, from which may be determined the agricultural products suitable to the different climatic conditions that prevail in different parts of the country, and so likely to be a commercial success; (2) investigation of the economic relations of birds to agriculture and horticulture, in order to determine what birds are useful and what inju-



rious to these interests and to what extent; and (3) the preservation and introduction of game, and also the supervision of the importation of foreign birds, to prevent the introduction of undesirable species, such as have caused much damage in other countries or are likely to become pests in this country.

#### DETERMINATION OF LIFE AND CROP ZONES.

In determining the feasibility of profitably raising a certain kind of crop for market the first question presenting itself is, Is the climate suitable? This question is largely determined by biological surveys or the investigation of the geographic distribution of plant and animal life. Lines are run through a State wherever necessary, and the plant and animal life and effects of physiographic and climatic conditions are carefully noted. From these lines maps can be made, showing the location throughout the State of life zones—in other words, belts that are adapted climatically to certain crops.

During the year the survey of Texas has advanced to such a point that a little additional work will permit the mapping of the life and crop zones and the publication of a full report of the biological character of the State. This survey should obviate many expensive agricultural experiments.

California presents peculiar difficulties to this work owing to the great diversity of climate found throughout the State, ranging from the Alpine summits of mountains, with their perpetual snow, to torrid deserts, hotter and drier than those of Africa, and including regions where frequent fogs and heavy rains prevail. The enormous agricultural interests of California, with its shipments of more than \$60,000,000 worth of vegetable products annually; add materially to the value of the final result. As soon as available funds and the difficult character of the country will permit, a biological map of the State will be published, which, it is believed, will be of inestimable service to agriculturists and horticulturists of the State.

It is very desirable to secure as much information as possible concerning Alaska, in view of the tide of immigration setting in toward that Territory and its consequent development. Work was carried on at several points in the Territory, choice being made of such as would yield the broadest possible results with the limited means available for the purpose. The base of the Alaska Peninsula, on both coasts, and several of the lakes and rivers of the interior, notably Lakes Iliamna, Clark, and Becharof, and the Chulitna, Nushagak, and Ugaguk rivers, were the field of exploration. This region is one of unusual importance for biological investigations, as it includes the northwestern limit of the Pacific coniferous forest and is the point of junction of several life areas.

## ECONOMIC RELATIONS OF BIRDS TO AGRICULTURE.

The study of the relations of birds to agricultural interests was continued under the two lines that have heretofore occupied attention, namely, laboratory work and field investigation. In the laboratory attention was mainly directed during the past year to the stomachs of game birds, in preparation for issuing a report upon their food habits, in order to meet a constantly growing demand upon the subject.

Field work included a continuation of investigations on a certain Maryland farm, which formed the subject of one of the bulletins of the Division issued during the year, and the study of the food habits of birds in the principal fruit-growing districts of California, begun in 1901. The California work, as noted in previous reports, has yielded important results, which will be very useful to horticulturists by making it apparent which birds are serviceable and which are injurious to their interests.

Complaints have been received by bee keepers in California of great harm to their business, caused by certain birds, which, it is alleged, destroy large numbers of worker bees. Partial investigations of this complaint do not sustain these charges, but further study is necessary before a final report can be made.

In many parts of the country serious loss is entailed on agriculturists by periodic invasions of noxious insects. When such outbreaks occur hereafter they will be investigated, if practicable, by this Division in conjunction with the Division of Entomology, in order to ascertain, as far as possible, what influence is exerted by birds in checking the increase of the pests and thus diminishing the extent of their ravages.

## GAME PROTECTION AND INTRODUCTION.

## ENTRY OF FOREIGN BIRDS AND ANIMALS.

The duties assigned to this Division relating to game protection are based on three acts of Congress—the Lacey Act of 1900, the egg act of 1903, and the Alaska game law of 1902. The permits required by the Lacey Act for the entry of foreign birds and animals numbered 387 during the year, and allowed the entry of 629 mammals and 53,106 birds. Under the egg act 2,000 eggs of game birds were imported. Importations of cage birds are made mainly at New York and San Francisco, though parrots are frequently entered at New Orleans and different ports of entry along the Mexican border. Pheasants of various kinds for propagation are imported from Canada in considerable number, coming chiefly through the ports of Detroit, Buffalo, and Niagara Falls. The animals that are brought into the country are almost entirely confined to such as are designed for exhibition purposes in circuses and zoological parks. Most of the importations of

cage birds are made by regular dealers, and are subject to the usual inspection. In the case of passengers bringing in a few birds as pets, it has been found desirable to obviate the annoyance sometimes caused by the delay needed to secure permits, and the facilities granted at New York have been extended to San Francisco. Under the arrangement thus made not more than five birds may be declared by passengers with their personal baggage before an officer of the customs and landed without formal permit. A strict account of the birds thus entered is kept by the customs authorities and reported quarterly.

The object of the law is to eliminate the danger of the introduction of birds or animals which might become serious pests. That such danger is constantly present is shown in the history of Australia, Porto Rico, Hawaii, and other countries, and is instanced by the introduction and spread in the United States of the European sparrow, and to a much more limited degree of the Old World starling. Although the entries at San Francisco are few as compared with those at New York, the danger of introducing injurious species at that port is probably greater than at any other. With a view to still further improving the service at San Francisco, a careful examination was made there in June of the peculiar conditions attending importations from Australia and the Orient, which, it is believed, will be productive of much good. It is hoped that all danger of the introduction of such species as may prove to be pests can be eliminated. So far as is known, the law has thus far been effective. Two mongooses from Jamaica were killed at Philadelphia; 1 mongoose from the Philippines and 2 flying foxes from Australia were destroyed at San Francisco; and 50 flying foxes that arrived at New York from Singapore in December were reshipped to Hamburg, Germany.

#### ENFORCEMENT OF GAME LAWS.

The cordial cooperation of the Attorney-General and State officials has enabled prompter disposition of cases arising from the illegal shipment of birds and game than ever before. Thirty-five such cases, involving the shipment of 3,729 birds, were reported to the Department, a decrease of four cases and about 1,300 birds from those reported during the preceding year. Since the passage of the act 40 convictions have been secured in cases passing through this Department, and about 20 cases are still pending. Efforts have been concentrated upon one or two areas in the West, where illegal shipments seem to be especially frequent, in order to secure more satisfactory results with the limited means available. Illegal shipment of game has been very frequent in the past, and various methods have been adopted to conceal the character of the shipment. The violators of the law have, however, been driven by increasing insecurity in their illegal trade to new devices. Thus, a consignment recently seized in



the Northwest disclosed game birds concealed in bales of hay which had been forwarded by slow freight. In the attempt to curtail these illegal shipments, I have been much aided by the cooperation, cheerfully and cordially given, of express and railroad companies, and there is reason to believe that illicit shipments can, at comparatively small cost, be reduced to a minimum and the great inroads they make upon the game of our country checked.

#### PROTECTION OF GAME IN ALASKA.

In Alaska, in the absence of a specific appropriation permitting the employment of competent wardens, it has been impossible to secure a reasonable observance of the game law. Much care has been exercised, however, in the case of the export of heads and skins, and the shipment of these from Alaska for purposes of sale in the United States in violation of the law has been practically stopped. Misinterpretation of the statute was the means of temporarily curtailing the trade in black bear skins, but the misconception has been corrected as far as possible.

#### PUBLICATIONS.

Under the provision of the Lacey Act requiring the collection and publication of useful information relating to the propagation, uses, and preservation of birds, posters and bulletins have been published annually, showing the close seasons and other provisions of the game laws of the United States and Canada, also lists of game officials in the various States, and other information of like character. The digest of game laws was issued as a Farmers' Bulletin in order to meet the demand and to place a sufficiently large number at the disposal of members of Congress. The compilation of laws relating to nongame birds has been of considerable service. Much of the rapid progress in the character of the legislation protecting birds is directly traceable to the dissemination of the information it contains, and it is noteworthy that the adoption of our system of bird protection has recently been strongly advocated in Brazil and Mexico.

#### RECOMMENDATIONS.

It has been found impracticable to transport, fence, and maintain elk and other animals on forest reserves and other public lands with the appropriation of \$1,000 made for that purpose. I have recommended, therefore, an increase of the appropriation to \$5,000 for the ensuing year.

The three distinct lines of work assigned to this Division could be conducted much more economically and effectively were the Division reorganized as a bureau of three divisions, each to have charge of one of these lines, and were a larger amount appropriated for the perform-



ance of the work. I have accordingly recommended such reorganization, with an increase of \$1,450 in the statutory roll and \$12,000 in the lump fund, in order to accomplish this change and meet the greatly increased demands of some of the sections of the Division.

### OFFICE OF EXPERIMENT STATIONS.

#### PROGRESS OF THE EXPERIMENT STATIONS.

The success of the agricultural experiment stations in leading the way to the improvement of agricultural practice on a grand scale is having as one of its effects a closer union between the stations and the farmers in enterprises directly affecting farm methods. This is leading to demands that the stations shall conduct at least a portion of their investigations in a larger and broader way, in order that the results of scientific investigations, whether in the field or the laboratory, may be more definitely and thoroughly applied in practice under the conditions actually encountered on the farm. A good example of this may be found in the recent cooperative experiments conducted by the Iowa Station at Odebolt, Iowa. The proprietor of a large farm at that place desired to know whether or not the by-products of corn, flaxseed, or cotton seed, or some of the prepared stock feeds when fed in conjunction with corn, would give better results than corn alone. He furnished 220 cattle and the corn roughage necessary for conducting a feeding experiment. The Iowa Station furnished the by-products and stock feeds and conducted the experiment. The first test gave results indicating that the addition of so-called condimental stock feeds to a corn and wheat-straw ration gave much lower returns per steer than corn and wheat straw alone.

One of the results of the thorough work of the Illinois station on the breeding of corn has been the formation of the Illinois Seed Corn Breeders' Association. The success of this enterprise has been phenomenal. All of the available supply of the improved seed is rapidly disposed of to farmers and much of it is engaged in advance. The work of this station on corn is proving to be far reaching in its results, not only in improving the general quality of seed corn, but in inducing practical men to undertake the breeding for special qualities—for protein, for oil or for starch—which the station has demonstrated to be entirely feasible. As a recognition of the value of such work, the farmers' organizations of Illinois have rallied to the support of that station, securing last year State appropriations aggregating \$46,000 for special investigations and this year nearly twice that amount, or \$85,000.

The Minnesota station has been extending its investigations in the breeding of improved varieties of wheat and other kinds of grain, making thousands of crosses, and, wherever promising new varieties

are found, testing them in a large way, both at the station and on hundreds of farms throughout the State.

The amount of data published by the stations on many agricultural subjects is now very large, and the recent attempts which have been made to reduce this material to organized form in order that it may be utilized for purposes of agricultural education have shown that the stations are doing a great work in supplying the materials out of which a definite science of agriculture is being constructed, and on which courses of instruction in agriculture of different grades can be successfully based.

If our stations are to be continued on the broad basis on which they are at present organized they must generally be supplied with larger funds for the general expenses of investigations in order to conduct their work in a thorough and satisfactory manner. The States can and undoubtedly will supplement the National funds more fully as time goes on, but since the results obtained by the stations are in many cases of general value to the agriculture of the United States, it is worthy of consideration whether they should receive additional financial aid from the National Government. This supplemental aid should, if given, be granted under conditions which will insure its exclusive application to meet the expenses of agricultural investigations.

#### THE AGRICULTURAL COLLEGES.

Special appropriations for the better equipment and maintenance of the agricultural colleges, aggregating more than \$1,250,000, have been made by the States during the past year. The movement in the direction of basing the courses of instruction in these institutions more largely on the science and practice of agriculture itself is continuing, and already has resulted in a considerable increase in the number of students pursuing agricultural courses. A special effort is now being made in a number of our strongest agricultural colleges to make their courses more complete by adding systematic instruction in farm mechanics and rural economics. Increasing attention is being given by these colleges to the holding of summer schools, one purpose of which is to prepare teachers for giving instruction in nature study and elementary agriculture in the common schools. The interest in work of this kind is especially strong in the South at this time, as is shown by the large enrollment of teachers in the Southern institutions. The attendance at the land-grant colleges for the year 1902 aggregated 46,699 students, of whom 6,299 were in agricultural courses. The graduates of these institutions in 1902 were 4,443, and since their organization, 50,026.

This Department is cooperating with the Association of American Agricultural Colleges and Experiment Stations in the preparation of

a comprehensive exhibit at the Louisiana Purchase Exposition showing the progress of agricultural education and research in this country.

#### SECONDARY AND ELEMENTARY SCHOOLS OF AGRICULTURE.

The attendance at the two county agricultural high schools opened in Wisconsin in the fall of 1902 was large, and the interest manifested in these schools was so great that the State legislature at its last session, recognizing the demand for instruction of this grade, made provision for additional county agricultural high schools with State aid. At the California Polytechnic Institute, San Luis Obispo, buildings have been erected and everything put in readiness for opening the school with agricultural courses this fall. The Mount Harmon School, near Northfield, Mass., founded by the late D. L. Moody, has decided to establish an agricultural department and to offer courses of instruction in that subject. The school already has an equipment consisting of a farm of about 1,000 acres, a dairy of about 200 cows, fruit orchards, and a cannery for putting up vegetables. Mr. Harry Hayward, a graduate of the school and for several months past assistant chief of the dairy division of this Department, has been called to the school as director of the agricultural department. This step on the part of one of the largest secondary schools of the United States is a matter of great interest to those who are following the progress of secondary instruction in agriculture, and is especially significant from the fact that the institution is not a technical school and this is the first attempt to establish an industrial course.

The committee on methods of teaching agriculture of the Association of American Agricultural Colleges and Experiment Stations made a report to the convention of this association held at Atlanta, Ga., in October, 1902, in which it showed that courses in agriculture could be introduced into the public high schools without any violent or radical reorganization of existing programmes for such schools.

Many of the officials in charge of our public high schools and elementary schools are also considering the advisability of introducing agricultural subjects into the curricula of these schools, more especially by giving an agricultural trend to nature-study work.

School gardens, meaning by the term flower and vegetable gardens utilized for educational purposes, are found in the East, the Middle West, the South, the far West, and our insular possessions. They are maintained in connection with the kindergarten and with every other grade up to the high school.

This Department has been aiding the school-garden movement in several ways. Through the Bureau of Plant Industry it has distributed special packages of vegetable and flower seeds to a large number of schools, and conducted a number of school-gardening experiments in cooperation with the schools and charitable organizations of Wash-



ington, D. C. Officers of the Department have in several instances volunteered to direct these experiments outside of office hours. One of the most successful of these experiments was conducted on the Department grounds with a class of 30 boys and girls from a near-by school, under the direction of the science teacher in the normal school of the city.

#### THE FARMERS' INSTITUTES.

In consequence of the action of Congress during the session of 1902-1903, making definite provision for the work of the Office of Experiment Stations relating to farmers' institutes, it has been possible to put this work on a permanent basis and to begin the formulation of a policy regarding its development.

As a result of a civil service examination, Prof. John Hamilton, of Pennsylvania, was appointed farmers' institute specialist. He has been for many years a lecturer and manager of farmers' institutes, and is thoroughly acquainted with their past development and their present needs.

Since the work of this Department relating to farmers' institutes is based on the principle of giving aid to the institutions maintained under the authority of the States, this Department has established the rule of working in this line through the State officers charged with the management of the institutes.

It is difficult to realize the extent and importance of the farmers' institute movement and its vital relation to the successful incorporation of the results of scientific investigations in our agricultural practice. Under present conditions, with the rapid changes in the personnel of our agricultural population and the almost entire absence of agricultural instruction in our elementary schools, it is of the greatest importance that our adult farmers shall receive definite information regarding improved methods of agriculture and the principles which lie at the foundation of progress in agricultural practice.

#### EXPERIMENT STATIONS IN ALASKA.

During the fiscal year ended June 30, 1903, experiment stations were maintained at Sitka, Kenai, and Rampart, and a new station established at Copper Center, the experimental work for the most part including the growing of cereals and vegetables, methods of reclaiming, draining, and fertilizing land, and the curing and ensiling of crops. The distribution of seed of hardy varieties of vegetables, cereals, and grasses has been continued and extended, and beneficial results have accrued, as is shown by the constantly increasing number of gardens and other plats of ground which are brought under cultivation. The supervision of voluntary observers of the Weather Bureau in Alaska has been continued as in former years, there now



being 20 meteorological stations which report to the experiment station at Sitka.

The new station which has been opened at Copper Center consists of a tract of about 775 acres, situated in the Copper River Valley, a little more than 100 miles from the seacoast. This tract of land has been withdrawn from entry by the Secretary of the Interior and set aside for the use of the station.

At the Kenai Station about 15 acres have been brought under cultivation and all the hardy vegetables, buckwheat, oats, barley, and other cereals are readily matured. Additions have been made to the buildings and a beginning made in animal industry. A record was kept of the milk yielded by a cow purchased for the station, which shows that over 29 pounds was produced daily from native pasture grasses during the months of June, July, and August.

At the Rampart Station the work begun in 1901 was confined to the growing of a few varieties of cereals, all of which matured finely. Winter rye sown from seed matured in 1901 successfully passed through the winter and matured a crop of fine grain. These results, attained at a latitude of  $65^{\circ} 30' N.$ , aid in demonstrating some of the agricultural possibilities of the country. Cooperative experiments have been carried on by Rev. C. P. Coe, who is in charge of the Baptist Orphanage at Wood Island, and these experiments have been conspicuously successful. Winter rye, spring wheat, barley, and oats were matured and a good start made with various tame grasses and other forage crops. Hardy vegetables were produced in considerable quantity, a sufficient amount being grown to supply the 40 members of the orphanage and leave a surplus for sale.

At the Sitka station considerable work has been done in finishing the headquarters building and in enlarging the farm buildings. A small nursery has been established, and several hundred apple trees and current, raspberry, and other shrubs are being grown for distribution when their adaptability has been demonstrated.

During 1904 efforts should be made to reopen and equip the station at Rampart. The conditions here are representative of the largest body of agricultural land in Alaska and embrace many thousands of acres.

At the Sitka station additional buildings are needed, and there is a demand for a scientific equipment, which should include a chemist, a botanist, and an entomologist, with the necessary laboratory equipments for their various lines.

It is highly desirable that work should be taken up with live stock, but at present this can be done only on a limited scale. The special agent in charge of the station has recommended the establishment of a temporary cattle ranch on Kodiak Island with a view of introducing some of the hardier breeds of cattle into Alaska. He believes that

the Galloway breed is adapted to the conditions in that territory and that southwestern Alaska is particularly suited to this investigation. For a number of years Congress has appropriated for the introduction of reindeer into the more northern part of Alaska, and it seems possible that in a similar way provision might properly be made for the introduction of cattle into the southwestern grass region.

#### HAWAII EXPERIMENT STATION.

The work of the Hawaiian Agricultural Experiment Station has been continued along the various lines of investigation previously described. Additional portions of the station land have been brought under cultivation, and additions have been made to buildings, fences, irrigation plant, etc., as occasion required and funds permitted. A special effort is being made to build up a working library, and the special agent in charge has contributed his private collection as a nucleus for a station library. The necessity for a well-equipped economic library is peculiarly felt in a region as isolated from library facilities as is this station.

During the past year a number of bulletins have been issued, giving the results of investigations which have thus far been carried on. The experiments begun in the previous year on taro rot and potato rot have been continued on an enlarged scale, and the results already obtained suggest the practicability of combating these diseases. One of the most destructive diseases of the taro may be prevented by proper attention to the irrigation water and to the application of suitable fertilizers. The potato experiments have been continued, and it is found that one form of rot may be successfully combated by the thorough use of Bordeaux mixture, and preliminary experiments seem to indicate that a second disease, which is due to a soil fungus, may be prevented to a very great extent by soaking the seed tubers in a solution of formalin and planting them in uninfested soils. These experiments are to be continued for a number of years in the hope that the results obtained in the preliminary investigations will be confirmed.

Formerly, the growing of corn was an important industry in Hawaii, but through careless methods of cultivation and the attacks of insects the growing of this crop has become an uncertain industry. Investigations have been begun by the station in which the effect of deeper plowing, the use of fertilizers, thorough cultivation, and the introduction of new varieties are tested. The preliminary results thus far obtained have given excellent results and two varieties which have been introduced—Leaming and Boone County White—seem to indicate that these varieties are particularly adapted to cultivation in Hawaii and are apparently more satisfactory than the so-called native varieties.

A collection is being made of the grasses and forage plants of the

islands, and it is hoped that a bulletin may soon be issued concerning them, which may contain notes on the native and introduced species, together with suggestions relative to their value for different purposes.

The investigations on injurious insects have been continued, and a serious outbreak of a mealy bug on alligator pears was prevented by prompt action.

The station is devoting considerable attention to the subject of fiber plants, and a bulletin has been issued on the sisal hemp in Hawaii and investigations are being carried on with Manila hemp and other fiber-producing plants.

Experiments with tobacco, especially with Sumatra leaf tobacco, grown in partial shade furnished by light cloth, have been apparently very successful and will be continued upon a larger scale. It is believed that there are a number of localities where Sumatra tobacco can be grown under shade at a decided profit.

#### PORTO RICO EXPERIMENT STATION.

Since the last report from the Porto Rico Agricultural Experiment Station a permanent location has been secured adjoining the city of Mayaguez and the station removed from its temporary location at Rio Piedras. The farm on which the station is situated had not been in cultivation for some time and a considerable portion of the season was taken up with clearing the land of shrubs and weeds, repairing buildings and roads, constructing fences, digging ditches, etc. As preliminary to planting, a number of acres was sown with general crops in order to bring the soil in condition for experimental purposes and incidentally test the adaptability of the different plants to Porto Rican conditions.

A beginning has been made to establish nurseries of citrous fruits and rubber and tea plants, as well as varieties of mangoes, bananas, and other tropical fruits. Arrangements have been made by which improved varieties of tropical fruits are being secured from different portions of the West India Islands through the courtesy of the commissioner of agriculture for the British West Indies.

Experiments have been commenced to test various fiber plants, and there are now growing at the station Manila hemp, sisal hemp, and a number of species of fiber plants which grow upon the island. Experiments are being conducted to test the value of various leguminous crops for restoring the soil, and thus far velvet beans and soy beans appear very promising. Cowpeas, which had been extensively sown, suffered severely from insect injuries. Alfalfa is also being tested with some promise of success.

The coffee investigations of this station have been continued at the coffee plantation La Carmelita. On this estate 10 acres have been placed at the disposal of the station for experimental purposes, and



the effect of different methods of pruning, shading, fertilizing, etc., are being tested.

During the early part of the fiscal year the botanist of the station visited the northeastern part of the island and made a report upon the native forest, which was fast disappearing. Based upon this preliminary survey a recommendation was made to the Secretary of the Interior that a forest reserve be set aside, and in January, 1903, the President proclaimed the Luquillo Forest Reserve of about 25,000 acres.

For continuing the investigations in 1904 the insular government appropriated \$2,700. This will be largely expended on permanent improvements and special investigations. Tobacco investigations and a soil survey of the island have been begun, but owing to the small appropriation the work could be but little more than a preliminary survey. It is desired that this work should be continued in cooperation with the Bureau of Soils of this Department, and it is recommended that the present law, which limits the soil investigations to the continental portion of the United States, be amended so as to permit of an extension of the work in both Porto Rico and Hawaii.

The cordial support which has thus far been accorded the station by the insular legislature, together with the interest manifested by planters in requesting its publications and in soliciting specific information, is very encouraging and bespeaks for the station a high degree of usefulness.

#### INVESTIGATIONS ON NUTRITION OF MAN.

During the last fiscal year the inquiry regarding the food and nutrition of man has been conducted along the same general lines as formerly, and has included studies of the nutritive value and cost of different food materials in various regions of the United States, special investigations with the respiration calorimeter on the transformation of matter and energy, studies of the changes brought about in cooking, the relative digestibility of different food products, and dietary studies.

Meats, legumes, cereals, fruits, and nuts have been the special subjects of the digestion experiments of the past year. The work with meat has included the study of the influence of cooking, as well as of age, breed of animal, etc., upon digestibility. The experiments with cereals have included the effect of the different methods of the milling of flour upon the digestibility of bread made from it.

Cooking experiments have been made only with meat and have included a study of the effect of cooking upon the flavor, palatability and digestibility, beef being usually used for the purpose. Generally speaking, the meat was cooked in a number of ways, the length of time of cooking, the temperature, etc., varying in the different tests. It



was found that the chief loss in weight during the cooking of beef, and doubtless of other meats also, is due to the driving off of water. When beef is pan broiled there appears to be no great loss of nutritive material. When beef is cooked in water from 3 to 20 per cent of the total substance is extracted and found in the broth. The amount of fat thus recovered varies directly with the amount originally present, i. e., the fatter the meat the greater the quantity removed. The amount of water lost during cooking varies inversely as the fatness of the meat, i. e., the fatter the meat the less the shrinkage due to loss of water. In cooking in water the loss of constituents is inversely proportional to the size of the piece of meat.

Dietary studies have been made in several widely different localities, and have included a study of the amounts of food consumed by people of varying occupations, age, sex, and circumstances. The purpose has been to secure data in regard to the kinds, amounts, and costs of food materials under different conditions, to give an opportunity for comparison with the data obtained by investigators in other countries, and to assist in establishing a general dietary standard. As a whole the experiments have given valuable results.

In accordance with the usual plan the investigations have been carried on in cooperation with agricultural experiment stations, agricultural colleges, and other educational institutions in different States, including California, Connecticut, District of Columbia, Georgia, Illinois, Maine, Minnesota, and Tennessee.

Nine dietary studies and thirty-one digestion experiments were made with fruits and nuts, these articles in nearly every case constituting all or almost all of the daily fare. The results obtained warrant the deduction that, as shown by their composition and digestibility, both fruits and nuts can be favorably compared with other and more common foods.

#### IRRIGATION INVESTIGATIONS.

The work of this branch of the Office of Experiment Stations during the past year has included:

The furnishing of information regarding the requirements and possibilities of irrigation, in both the arid region and the East, to a large number of farmers who either contemplate emigrating to the West or adopting irrigation as an aid to agriculture in the East.

The making of special studies and furnishing expert advice to communities about the methods of distributing water to lessen losses from seepage and evaporation, and about the preparation of plans for draining land in both the arid and humid parts of the United States.

The making of original investigations in order to discover the best methods of handling water and thus promote the largest and best development of the country, and to gather the facts needed to answer

the inquiries which come to the Department. These may be grouped under the following heads:

In the acts making appropriations for these investigations Congress has provided that wherever possible the Department should cooperate with agricultural colleges and experiment stations in the several States. Experience has shown that this is a wise provision, as it enables this Department and the State stations to obtain much larger results than would be possible if each carried on its work alone. It is believed that the arrangement is equally advantageous to both parties. In accordance with the provisions of this act we have made arrangements for cooperative work with a number of the experiment stations of the East, where irrigation problems are assuming considerable importance, and with all of the experiment stations of the arid region, except two. In three States special appropriations have been made by the State legislatures to aid in extending this cooperative work. The Department is also receiving appreciated aid from the various State engineers' offices of the arid States.

#### DUTY OF WATER.

At the outset of these investigations the Department made an extended study of the quantity of water being used in irrigation under existing methods. This knowledge was needed by courts in the establishment of titles to water, by canal companies in planning and operating irrigation works, by farmers in making water-right contracts or in building ditches for themselves, and it was also an indispensable basis for an intelligent effort to bring about a more economical use of water by the improvement of methods, as well as to furnish advice to the large number of persons who each year undertake irrigation for the first time.

The work of the past year and that planned for the future is to promote the adoption of improved methods. It includes the determination of the amount of water needed to give the best results, the time when it should be applied, and the methods of application best suited to different localities and different crops. In this investigation experiments are being made in which the water actually used by plants is being measured. With this as a basis, the additional quantities necessary to supply evaporation and other losses, which are unavoidable under any conditions, can be determined with greater exactness. The same problem is being taken up from the practical side. Experimental fields have been planted. In these fields different quantities of water are being applied to crops where all other conditions are made as nearly uniform as possible. In this way a quantity of water which will produce the largest returns can be determined.

A prominent feature of the reports made by our agents in 1902 is a discussion of the evils resulting from the use of too much water, the

swamping and ruining for the present of large areas which were only a few years ago highly productive farms. The first remedy which suggests itself is to stop using more water than is necessary, and the work of the Department just outlined is for the purpose of determining what is necessary. Farmers can not make these experiments for themselves because they are dependent upon what they grow for a living and must apply enough water to make sure of the crop. It is, therefore, the duty of this Department to make the experiments, and the benefits certain to accrue fully warrant the outlay. The use of water in excess of the needs of crops not only reduces the yields and ruins large areas of fertile lands, but it deprives other lands equally fertile of a water supply. There is an area of approximately 10,000,000 acres now under irrigation, and canals already built cover an added area of at least 5,000,000 acres. Our work in the past leads us to believe that the use of better methods on the areas now irrigated will make possible the cultivation of the added 5,000,000 acres now under ditch with very little added expense for canal construction. Reduction of yields by the failure to use the proper quantities of water is reason enough to justify the work being done on this line, but the damage done by the surplus makes the continuation and enlargement of this work of great public interest.

The work so far outlined deals with those parts of the United States where no crops can be raised without irrigation. Scattered throughout the arid States, and in the regions between the Missouri River and the Rocky Mountains, there are large areas where crops can be raised without irrigation, but where the productivity would be greatly increased by the use of more water and by methods of cultivation which will conserve the supply of moisture which they already have. The agent in charge of our work in Oregon estimates that there are 3,000,000 acres of agricultural land in that State whose products can be greatly increased by the adoption of proper methods for conserving the moisture which falls outside of the irrigation period, and equally good results can be obtained in other States. In Kansas the best methods of utilizing small sources of water supply are being studied, and experiments are being carried on.

SEEPAGE.

Measurements of former years have shown that the losses from canals by seepage are much greater than have been commonly supposed. The Department is carrying on a series of investigations to determine the best means of preventing these losses. Measurements of a large number of canals show that as a rule the greater losses occur in the comparatively short sections. If these sections could be improved, the leakage would be greatly reduced. In many cases irrigators do not make use of more than 50 per cent of the water entering



the headgates. The saving of these waters, therefore, means an increase of more than 50 per cent in the available supply, or the doubling of the area irrigated, but the benefits to come from this saving will be more than this gain in crops and in watered area. Seepage water from canals and laterals not only often finds its way where it can not be available for irrigation, but it also prevents the cultivation of large areas of land through the rise of ground water until the land becomes too wet for crops. This also brings up the alkali which has been dissolved and makes the land still further unfit for cultivation. The facts being gathered enable the Department to advise farmers and canal managers as to the best plans for distributing water to their fields at the least expense and with the least loss.

Leakage from ditches is a very serious question in the extension of irrigation in the eastern part of the United States. It has been found practically impossible to irrigate the sandy lands of Florida by unlined earthen canals, as the water all sinks before it reaches the grounds to be irrigated. There has been a similar experience in both Wisconsin and New Jersey, and experiments are being made to determine whether or not some cheap and feasible system of lining canals and distributing water can be found.

#### DRAINAGE.

Requests from communities for advice about the removal of seepage water have been so numerous during the year that it has been beyond the means of the Department to respond to all of them, and it will be necessary to extend this work in the future. There is a special reason why the Government should lend this aid. The injury to each farmer's land does not come from his own neglect or wasteful use, but from the watering of other areas, which action is being encouraged by the Government, so that the individual settler in many instances is a victim of the country's growth and of a recognized State and National policy.

Numerous requests have also come to this office for advice about agricultural drainage in the eastern part of the United States, and especially in the South and Middle West, where there are large areas of fertile land which, if drained, could be made immensely productive. The drainage of such lands is beyond the means of the individual settler. The public welfare will be greatly promoted by having this work done. Every consideration which justified the extension of aid in the reclamation of arid lands applies with equal or greater force to the furnishing of needed advice about the reclamation and improvement of this overwatered land, because it would have exceptional value. Its fertility has not been exhausted by long cultivation, and it is located where transportation is cheap and where there is direct access to densely populated districts. The farmers are there, the markets are



there, and the soil is there. In the aggregate, these swamped areas have a productive capacity equal to four times the State of Illinois, and the inauguration of their improvement takes rank among the important public agricultural movements of the country.

IRRIGATION IN THE EASTERN PART OF THE UNITED STATES.

Irrigation in the humid portions of the United States is proving profitable and is becoming an important factor in the production of certain crops. The irrigation of rice in Louisiana and Texas has added largely to the prosperity of those States and is being rapidly extended. The methods employed differ widely from those used in rice irrigation along the Atlantic seaboard, and the Department is aiding farmers by gathering data as to the quantity of water needed, the best methods of raising it from streams, the cost of pumps, engines, fuel, the construction of laterals, and time and method of applying it. In the South Atlantic States rice culture is having to contend with some troublesome conditions created by the cutting off of the forests on the headwaters of streams. This has filled river channels with the soil washed from the hillsides, and has forced rice growers to contend with a wider fluctuation in streams. A partial investigation of the problems confronting the rice growers in this section has been made to determine the feasibility of providing a supplemental water supply in times of scarcity and also to advise the farmers regarding the best means of protecting their dikes from floods.

An investigation of the requirements of cranberry irrigation is being carried on in cooperation with the State Experiment Station of Wisconsin. This investigation includes a study of both the irrigation and drainage requirements of this crop. The success of the cranberry industry depends upon the proper use and control of water. It must be applied at the right time, and it must be withdrawn quickly at the right time. Until the last few years no attempt was made by cranberry growers in Wisconsin to exercise control over the water. If nature failed to cover the vines at the right time or uncovered them at the wrong time the crop would suffer. The severe drought of 1895 almost destroyed the industry in that State. With its revival better methods are being adopted; dams are being built to collect the surface water; canals are being constructed to carry water pumped from streams. The development of the industry and the extension of the area under cultivation have brought new difficulties. More water is needed, requiring larger ditches. Greater uniformity in the matter of drawing off water is imperative to prevent the operations of one neighbor damaging those below him. Much litigation has been caused by a lack of arrangements for cooperation and by the construction of inadequate works. This calls for more knowledge as to the principles

which should govern in this work, which this Department is endeavoring to collect and provide.

The results of the present year, while not conclusive, show how greatly the success of this industry will be promoted by an efficient system of canals for getting the water onto the ground and getting it off. On June 11 of this year there was danger of frost. Those who had proper ditches saved their crops. Those who were not so provided lost them. A conservative estimate of the loss in the Cranmoor and Mather regions places this loss at \$25,000. The damage due to improper drains in this region which prevented the removal of the water in time was greater than that from frost, so that from these two items in the two districts there was a net loss this year of over \$75,000, a sum which would probably be nearly sufficient to construct a system of canals to meet the demands of both districts.

The severe drought which prevailed in the New England and North Atlantic States during the early part of the present summer not only showed the importance of irrigation to market gardeners and others growing high-priced products in this part of the country, but gave an excellent opportunity for observing the effects of irrigation where it was made use of. The facts regarding the operation of a considerable number of private irrigation plants have been collected and will be published for the information of others wishing to undertake similar work. There were also carried on in New Jersey some systematic studies of the effect of irrigation upon asparagus, other vegetables, and small fruits, and on the sandy lands in the southern part of the State.

#### FOREIGN STUDIES.

The law requires that this Department shall investigate irrigation methods and laws of foreign countries. A report on Egyptian irrigation has been published, and during the past year a study of the methods of operating canals and distributing water among farmers in Italy has been made. Both of these have shown that foreign countries have many ideas and practices which we can study to advantage, and these studies of foreign systems should be continued until our farmers are informed as to the methods of every country in the world where irrigation is practiced.

#### AGRICULTURAL ENGINEERING.

Attention has been previously called to the importance to American agriculture of bringing about improvements in our practice along a number of branches of engineering. But so pressing has been the demand for investigation relating to irrigation that it has not been possible, with the funds at the command of the Department, to do any considerable amount of work in other lines of agricultural engineering. The studies in drainage, apart from those relating to irrigation,

which it has been possible to make, have been of great value to a number of districts in the East, and these should be extended.

The studies of pumping should also be extended, in order to answer more definitely the many inquiries which are coming to the Department for information and advice. Already thousands of farmers are pumping water for irrigation and thousands of others are thinking of doing so. They write to this Department asking the amount of water required and the size and kind of pumps necessary to furnish it. It is certain that irrigation by pumping will greatly increase in the future, and the money value to farmers of having pumps operated efficiently will be proportionately enhanced. Pumping is also being used to relieve land which has been injured by seepage, and altogether this field is one of the most promising in which we are engaged, and nothing should interfere with continued work on this line.

While the study of power is being made primarily with relation to its use in running pumps, the information collected will prove useful in other lines of farm work. The long-distance transmission of electricity has made it possible to utilize the power of streams so cheaply that it can be profitably applied to many classes of farm work. Competition makes it necessary for our farmers to adopt every means of cheapening production, and the use of this power for operating farm machinery promises much in this line. Power has been largely used on great ranches, but has not been adapted to the needs of the man who is farming on a small scale and doing his own work. The work now being done by this Department is of especial value to this class of home-making farmers, as it will help to put them in a position to compete with those who can take advantage of the economies made possible by doing things on a large scale.

Closely related to this has been the growing interest in a number of our strongest agricultural colleges in the development of courses of instruction in farm mechanics. The increasing use of large, complicated, and expensive machinery in connection with farm operations has led to a demand on the part of the students attending the agricultural colleges for definite instruction regarding the construction and use of such machinery. Important problems regarding the further application of steam, gasoline, electricity, and other kinds of power to farm purposes are also being brought home to these institutions to solve in the interests of our farmers. The manufacturers of farm machinery, realizing that experts trained in the science and art of agriculture as well as in mechanics and engineering would make their most efficient helpers, are beginning to look to the agricultural colleges for such men. The colleges attempting to establish courses in farm mechanics and other lines of agricultural engineering are immediately made aware of the fact that the data for the scientific and pedagogical basis of such courses are very meager, and they are therefore looking to this



Department to aid them in instituting investigations to supply this information. Since it has seemed to this Department that this field of investigation was clearly within the scope of existing law, it has begun to aid the colleges along this line. With our present resources only a very limited amount of work in this line can be undertaken, and I have therefore recommended that \$10,000 be appropriated to enable this Department to extend its operations in agricultural engineering, especially on the application of power to farm machinery.

In order that the work of this Department in lines of agricultural engineering other than irrigation may be more definitely recognized, and organized on a more permanent and satisfactory basis, I recommend that Congress change the wording of the appropriation act so as to make the general title of this division of our work "Irrigation and Agricultural Engineering."

#### OFFICE OF PUBLIC ROAD INQUIRIES.

The National Good Roads Convention held at St. Louis, Mo., April 27 to 29, 1903, in connection with the opening of the Louisiana Purchase Exposition, was probably the most important meeting of the kind ever held in the United States. It brought together a greater number of influential citizens than any previous road convention. Addresses were delivered by the President of the United States, several governors of States, and members of Congress, besides prominent men engaged in agricultural and commercial pursuits, railway transportation, and journalism.

The work of testing the chemical and physical properties of road-building materials has been continued by the road-material laboratory, which is conducted in the Bureau of Chemistry in cooperation with the Office of Road Inquiry.

#### COOPERATIVE FIELD WORK.

The cooperative field work of the Office deserves special mention. Work of this kind usually results from an invitation extended to the Director by local or State authorities, an agricultural experiment station, or a good roads association. The Department furnishes only the services of its road experts. The materials are supplied, and the expenses of the work paid, by the other factors in the cooperation. The machinery employed is usually furnished free of charge by the manufacturers, who thereby secure an advertisement of their wares; and the railroad corporations usually transport such machinery free on account of their interest in road improvement as a means of developing the country tributary to their lines. The end in view is the construction of a short section of object-lesson or experimental road. Such work furnishes opportunity to test local road-building materials,



and gives the people of the locality an object lesson in methods of preparing the material and constructing the road; and the finished road serves to teach the worth of a good hard road to all who travel over it. In nearly all cases the value of such work is greatly enhanced by the holding of a convention while the work is in progress. This brings together a large number of persons, who not only secure the benefit of the object lesson, but who listen to addresses on all phases of the road question.

Cooperative field work of the kind just described has been carried on to a greater or less extent during the last five years, and its practical value has been amply demonstrated. It certainly yields a maximum of good results at a minimum of expense to the Government. The Director of the Office has recently secured reports from many localities where experimental road work has been done, and they uniformly show that the work was well done and that the object-lesson roads built led to a general improvement of the roads in those localities. During the past year more cooperative field work has been done than in any preceding year, and the demand for Government aid of this kind is greater than ever before.

For greater convenience and efficiency in carrying on the field work of the Office, the country has been laid off into four main divisions, with a special agent in charge of each.

#### GOOD ROADS AND RURAL FREE MAIL DELIVERY.

The intimate relation which exists between good country roads and rural free delivery of mail can not be too strongly emphasized. Communities which would enjoy the latter must make and maintain the former. In many instances bad roads have prevented the extension of rural free delivery to communities where it was greatly desired, and in some cases have caused suspension of routes already in operation. The desire for extension of the service should, and doubtless will, act as a powerful stimulus to road improvement in many localities.

The work of the Office of Public Road Inquiries appears to be no longer of a tentative character. Year after year it assumes increased importance and wider scope. That it will be a permanent feature of the Department's work hardly seems open to question.

#### DIVISION OF ACCOUNTS AND DISBURSEMENTS.

The extension and rapid growth in the work of this Department necessitates an increase in the estimates for each year. These estimates are prepared in the Division of Accounts and Disbursements and transmitted to the Congress through the Secretary of the Treasury and all expenditures are made under the supervision of that

Division. The appropriations for the fiscal year ended June 30, 1903, including \$510,000 for deficiencies, were \$5,013,960, an increase of \$1,091,231.54 over the preceding year. The expenditures during the year amounted to \$4,296,882.60, leaving a balance of \$717,077.40, but, the greater part of this sum is covered by outstanding liabilities.

All accounts for the fiscal year 1901 having been settled, the unexpended balances of appropriations for that year, amounting to \$65,127.50, were covered into the Treasury on June 30, 1903.

There was received and deposited in the Treasury the sum of \$12,803.56. Of this amount \$4,026.69 were received from the sale of American products in Europe, \$382.75 from sales of agricultural products of the agricultural experiment station in Hawaii, \$782.45 from the station in Porto Rico, and \$548.15 from sales of experimental shipments of fruit to Europe.

The amount paid for rent of buildings in the District of Columbia for the use of the several branches of the Department was \$21,700. The amount appropriated for the same purpose for the current fiscal year, 1904, is \$27,900, an increase of \$6,200.

#### DIVISION OF PUBLICATIONS.

The work of the Department of Agriculture in all its branches is necessarily reflected in the work of the Division of Publications. As all the other bureaus and divisions contribute to the acquisition of information, so the Division of Publications is the channel for its diffusion. Therefore, no possible enlargement of the work of the Department in any particular branch can be conceived of which does not ultimately add to the work of the Division of Publications. It is not within the province of its chief to restrict its work, but only to direct and control it to the best of his ability and with the means at his command. These facts explain quite logically the continued growth in the work of this Division.

Until last year the largest number of publications issued in any twelve-month period was 757 in 1902. The total number of publications issued during 1903, however, was 938. Of the publications issued in 1902, 355 were new. The new publications issued in 1903 amounted to 375, showing that the bulk of the increase in the number of publications issued consisted of reprints, which in turn indicates a continued and pressing demand for the Department publications. While the new publications show but a small increase in number, the number of pages they contain shows an increase of 17 per cent over 1902. The total number of copies of all publications issued during the year aggregated not far from 12,000,000.

The publications known as Farmers' Bulletins seem to satisfactorily supply a widely felt want. Of the total number of copies of all pub-

lications issued during the year nearly 7,000,000 were Farmers' Bulletins, and of these nearly 4,000,000 copies were distributed, as provided by law, under addressed franks supplied by Senators, Representatives, and Delegates.

In spite of the generous supply of publications, it is constantly necessary to refuse requests, owing to the editions being exhausted and means lacking to furnish a further supply. Under these circumstances I have found it desirable to restrict free distribution abroad to Government and other public institutions and to a few persons engaged in lines of work analogous to our own and actually cooperating with us.

The figures showing the number of publications issued and distributed by the Department would suggest to casual observation that the number was amply sufficient to supply all possible demands. Such, however, is far from being the case. A careful consideration of the applications received afford conclusive evidence that only a comparatively limited number of the nearly 7,000,000 farms in the United States are reached by the publications of this Department. This is a matter of regret, as the full value of the information acquired by the Department can unquestionably be realized only by a prompt and widespread diffusion to all those who might be benefited by it. It is a striking evidence of the general appreciation of the information the publications of this Department contain that over 30,000 copies were sold by the Superintendent of Documents in the face of the enormous free distribution, and that official has moreover declared that the number sold would be twice as great were he able to supply the demands. This suggests the desirability of setting aside, to defray the expense of reprints, the sums received by him for publications sold through his office.

The conservative course recommended by yourself in the matter of illustrations has been carefully followed, the rule adopted being to exclude all illustrations not necessary or at least essentially helpful to the understanding of the text. It is impossible for this Department, for reasons sufficiently obvious from what has already been said, to further restrict the output of publications. In view of the increase in the work of the Division of Publications and the causes which promise its continuance in the future, I have felt constrained to recommend some increase in the appropriations for its use.

#### THE LIBRARY.

The work of the Library increases from year to year with the growth of the Department, and with increased appropriations it is better able each year to meet the varied demands made upon it. The collection of books and pamphlets now in the Library numbers about 80,000, and contains many books and periodicals found in few, if any other,

libraries in the country. Agricultural workers in all parts of the country look to this Library more and more for assistance in the way of loans of books, verification of references, and preparations of subject lists.

#### ACCESSIONS.

A larger number of purchases have been made during the past fiscal year than in any year previous. Many new scientific serials have been added to the list of subscriptions, and the list of general agricultural, technical, and scientific periodicals acquired by gift and exchange has been largely increased. The present policy of the Department in the distribution of its documents enables the Librarian to arrange exchanges with many foreign as well as American scientific institutions and societies whose publications form valuable additions to the Library.

#### TECHNICAL WORK.

The Library has continued the publication of its quarterly bulletin of accessions. The recently adopted subject arrangement of the bulletin has proved to be an added convenience for reference use. Beginning with December, 1902, catalogue cards for current accessions to the Library have been printed at the Library of Congress. Extra copies of these printed cards can be purchased at small cost on application to the Librarian of Congress. A reprint of the index cards for the Year-books and the Farmers' Bulletins is in progress to meet the demands from the smaller libraries in the country for indexes to these popular publications of the Department. Provision has also been made for extending this index work to include index cards for some of the most important agricultural periodicals. During the past year there have been requests from several agricultural colleges and experiment stations for suggestions and aid in reorganizing their libraries. Assistance of this kind has been given whenever practicable, and the Department will continue such aid to further the organization and development of agricultural libraries.

#### NEW BUILDINGS FOR THE DEPARTMENT.

It is gratifying to announce that Congress, at its last session, authorized the expenditure of \$1,500,000 for the erection of new buildings for this Department. Two hundred and fifty thousand dollars was appropriated to inaugurate the work and as soon as the money became available steps were taken to secure the necessary plans and specifications. At the outset, some difficulties were met in the matter of reaching satisfactory conclusion with the architects. These matters were not finally settled until early in September of this year, when the contract for the preparation of plans and specifications was awarded to the firm of Rankin, Kellogg & Crane, architects, of Philadelphia.



The Department is now occupying 137,963 square feet of net floor space, 75,771 square feet of which is in rented buildings. In order to accommodate the present needs of the Department alone this amount of space would have to be increased fully 25 per cent. The Department of Agriculture is different in its requirements, so far as buildings are concerned, from other branches of the Government. Our work is largely of a research nature. Laboratories, therefore, are essential and form a considerable portion of the room required. A committee of Bureau chiefs in the Department, consisting of Doctors Galloway, Salmon, and True, has given careful consideration to the varied needs and have made recommendations, which I approve, that the best interests of the Department will be subserved by providing for a series of buildings connected with pavilions in such a way as to make practically one harmonious structure. The chief advantage of this plan is that it can be laid out in such a way as to be added to indefinitely from time to time, as the needs of the Department grow. These ideas formulated by the committee have been further developed by the architects, with a result that a series of buildings has been designed, the central feature of which is an administrative structure. Grouped about this are laboratory buildings to be used by the large bureaus in their research work.

The scheme, as a whole, provides for the erection of ten buildings, all suitable for the class of investigations which the Department must necessarily carry on. The amount authorized by Congress will suffice for the erection of three of the laboratory buildings, but it will not be sufficient for the erection of the administrative structure. The three buildings will have in them floor space of 100,000 square feet and will enable the Department to comply with the law, in so far as bringing within these structures all those branches of the Department that are now paying rent. The three buildings contemplated will be completed within the appropriation authorized according to the estimates secured at the present time.

#### CRISIS IN COTTON PRODUCTION.

The invasion of the cotton boll-weevil has been a special menace to our cotton crop, and has done more than anything else to awaken widespread apprehension as to the future of this most important crop. The boll-weevil first appeared in the State of Texas in 1894, and from that time on has been under observation and investigation by the Department through its Division of Entomology. It was not until 1902, however, that this branch of the Department was able to undertake anything like thorough and systematic work in the matter of studying this very destructive enemy of cotton. In 1903 the scope of the work was further enlarged, an appropriation of \$20,000 being made in the Division of Entomology for the investigations. Aside from

this work the Bureau of Plant Industry has, during the past year, been carrying on considerable work with a view to securing, if possible, early and resistant varieties by breeding and selection; and has been conducting some more or less general experiments in the matter of crop diversification at special points in Texas. It has also been engaged in distributing a considerable quantity of cotton seed of early maturing and promising sorts.

The work of the Division of Entomology has shown conclusively the value of good cultural methods, the planting of early-maturing varieties, and the destruction of weevil-infested material, this conclusion having been reached only through the careful and detailed studies of the life history and habits of the insect. The demonstration work along these lines, which the Division carried on the past year, has been exceedingly promising, as it has been shown that cotton can be grown in remunerative quantity, despite the presence of the weevil. Notwithstanding what has been accomplished by the Department, however, the fact remains that the boll weevil is constantly spreading north and east, and it is probably only a question of time when it will reach all of the cotton-growing States. Thus the country is confronted with a very grave problem, as the invasion of this insect must necessarily mean a complete revolution in present agricultural methods. During a recent visit to some of the Southern States considerable time was spent in the weevil-infested district, and from the facts gathered in this way I am convinced that energetic measures must be adopted to meet the present emergency. After thoroughly canvassing the situation with representative men in Congress and with others, I am of the opinion that a cotton investigation fund should be appropriated and set aside for immediate use in connection with this most serious problem. In order to make the work comprehensive and thoroughly effective, I am of the opinion that a sum not less than \$500,000 should be made immediately available for this purpose, the same to be expended under the direction of the Secretary of Agriculture, in such manner as will give the most immediate practical results. As to the problems which might be handled by the Department with such a sum available, I would respectfully call attention to the following:

#### RECOMMENDATIONS.

1. CHECKING SPORADIC OUTBREAKS OF THE WEEVIL.—It would seem highly important that some action be taken looking to the checking, if practicable, of sporadic outbreaks of the weevil in the territory immediately adjacent to that now infested. This could best be accomplished by the organization of a corps of competent entomologists and could be carried on in cooperation with the State authorities. In order to make this work thoroughly effective it will be necessary for the States interested to enact proper legislation. This is a matter that

could be handled and guided by those in authority, working under the direction of the Secretary of Agriculture.

2. DEMONSTRATION WORK TO SHOW THE VALUE OF IMPROVED CULTURAL METHODS BY WHICH FARMERS CAN PRODUCE FAIR CROPS IN SPITE OF THE WEEVIL.—This is the most promising field for immediate relief, and owing to the fact that the weevil is so far confined to Texas, the work here outlined would necessarily be limited more or less to this State, although regions in adjacent territory should also have such investigations carried on in them in order that the people may become enlightened in advance of the insect's ravages. The object and scope of the work would be to show by actual demonstration experiments the value of better cultural methods, the value of early maturing varieties, and the value of and necessity for complete and thorough destruction of all infested material. To carry out this work thoroughly and effectively would require a corps of men familiar with cultural conditions, and who have the knowledge and ability to direct the necessary specific work that might be ordered by the Secretary of Agriculture. Legislation would be required in this case, also, to enforce the destruction of infested material; but, under proper organization, this could be brought about.

3. WORK HAVING FOR ITS OBJECT THE PRODUCTION OF NEW, EARLY, AND IMPROVED VARIETIES OF COTTON.—The value of early varieties has been demonstrated, but most of them have serious drawbacks in that they are poor yielders and the lint drops out easily during storms. These matters may be corrected by proper breeding and selection, and one of the important problems would have for its object the taking up of this work on a systematic scale, to the end of securing sorts which would not only be early, but would be storm-proof and resistant.

4. STUDIES OF COTTON DISEASES.—While the boll-weevil is mainly in the public eye at present, the fact remains that other serious pests of cotton cause great losses annually. It is natural to attribute all losses at the present time to the insect in question, whether these losses be from other insects, diseases, floods, droughts, or whatever source. Reliable studies indicate that the loss in Texas alone from the so-called root-rot disease will, in all probability, aggregate several millions of dollars annually. This and other diseases should be thoroughly studied, and corrective measures should be adopted.

5. COTTON INSECTS.—What is said of cotton diseases is also true of cotton insects (especially of the boll-worm) other than the boll weevil. These should all receive careful attention, and practical experiments should be carried on with a view to lessening the injury caused by them.

6. INTRODUCTION OF NEW CROPS.—The urgent necessity for the introduction of other crops which will take the place of cotton can not



be too strongly emphasized. Cotton, of course, should be grown, but the time is evidently at hand when a concerted effort should be made to bring about a change in Southern agricultural conditions in the direction of greater diversification. This is recognized now as a vital question in the South. In many sections already the yield of cotton is barely profitable, so that, when the reduction due to the boll-weevil and other pests is taken into account, it will be necessary to abandon cotton growing altogether; while the decreased yield in the best districts of the cotton-growing sections renders it more important that other crops should be grown. Such crops as alfalfa, sorghum, Kafir corn, and cereals of various sorts should all receive attention, not only for silage, pastures, and winter forage generally, but for green manures as well.

7. STUDIES AND EXPERIMENTS IN CONNECTION WITH METHODS FOR THE DESTRUCTION AND CONTROL OF THE BOLL-WEEVIL, AND OTHER COTTON INSECTS.—It would seem highly important that the Government should take cognizance of the many devices which are being placed on the market for combating the weevil and other insects. This is necessary, as much for positive as negative results. Hundreds of devices and nostrums are offered to the public, and people are led to spend money for them. The Government should be in position to determine, once for all, the value or nonvalue of such devices, and thus be able to definitely and positively advise on all matters of this kind. Aside from this, the Government should take the matter of mechanical devices under thorough consideration, and should encourage, by the utilization of mechanical experts, the construction and use of everything which gives promise of practical value.

8. STUDIES OF ENEMIES OF THE INSECT.—While the studies of the enemies of the insect have had, so far, no practical result, there is no doubt that this work should be continued, and everything in the nature of enemies, whether they be predaceous or parasitic insects, birds, fungus parasites, or others, should receive careful attention.

9. SECURING AND DISTRIBUTING SEED OF COTTON KNOWN TO HAVE SPECIAL VALUE FOR EARLINESS AND ABILITY TO RESIST THE WEEVIL.—Systematic action should be taken in the matter of securing from every source available seed of promising varieties and thoroughly testing them in the weevil-infested district. In addition to this there should be a systematic endeavor to bring together desirable varieties from all available sources for advance trials in the sections where the insect is likely soon to make an invasion.

10. GENERAL PROPAGANDA.—Under this head there should be organized a competent corps of efficient workers, who could, with the cooperation of the agricultural colleges, farmers' institutes, State boards of agriculture, and all such organized bodies, bring to the



attention of planters everywhere the latest results as to methods of meeting the present emergency.

To carry out the foregoing work effectually, it is believed that the best results will be secured by a separate organization. It will be seen that the two branches of the Department primarily interested in this matter are the Bureau of Plant Industry and the Division of Entomology; and their officers and men would be in position to effect the proper organization and to direct the main features of the work. I would, therefore, respectfully recommend that, if the amount already mentioned be set aside as a cotton investigation fund, the Secretary of Agriculture be authorized to take such steps in the perfecting of a proper organization for handling the work as, in his judgment, may be best. Owing to the very nature of the investigations, and the fact that they will involve most thorough and far-reaching scientific work, the management of the general plans must necessarily rest with the Department. It is believed that the work can be strengthened by securing the advice and cooperation of one or two thoroughly practical men in the States most directly interested, viz, Louisiana and Texas. The Secretary of Agriculture, however, should have full authority to organize the work for the sole object of securing, as already indicated, the most immediate practical results.

In order to more effectually handle the problems which must necessarily fall to the work of the Division of Entomology, I have already recommended in my estimates that this important branch of the Department be made a bureau. The work that it has done in the past, especially in the field in question, certainly justifies this action; and I most earnestly recommend that this matter be given primary consideration in connection with the entire problem. It is very desirable, furthermore, that the fullest cooperation be effected by the Department with the experiment stations in the respective States, where the more important work will be conducted. This is especially true of Texas, where the Agricultural College is doing everything in its power to aid in the matter, but where it is more or less handicapped by lack of proper facilities and funds.

The fund recommended to be set aside for the purposes mentioned, and used in accordance with the plans outlined, will give the Department such liberty of action as the exigencies of the case demand. An industry which brings to the country an annual income of something over \$500,000,000 is threatened, and the time is at hand for energetic action. I again, therefore, most earnestly renew my recommendations for the means and authority to carry out the plans as herein set forth.

Respectfully submitted.

JAMES WILSON,  
*Secretary.*

WASHINGTON, D. C., *November 28, 1903.*

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# DEPARTMENTAL REPORTS.

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## REPORT OF THE CHIEF OF THE WEATHER BUREAU.

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U. S. DEPARTMENT OF AGRICULTURE,  
WEATHER BUREAU,  
*Washington, D. C., August 11, 1903.*

SIR: I have the honor to submit a report of the operations of the Weather Bureau during the fiscal year that ended June 30, 1903.

Respectfully,

WILLIS L. MOORE,  
*Chief of Weather Bureau.*

Hon. JAMES WILSON, *Secretary.*

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### WORK OF THE YEAR, WITH RECOMMENDATIONS.

#### FORECAST DIVISION.

##### PRACTICAL VALUE OF FORECASTS AND WARNINGS.

The North Atlantic and West Indian forecast and storm-warning service was continued in successful operation during the year. Forecasts for the first three days out of steamers bound for European ports were issued daily at 8 a. m. and 8 p. m., and American and European shipping interests were notified of the character and probable course of the more severe storms that were passing eastward from the American coast.

No storms of hurricane strength occurred in the West Indies.

From October 31 to November 5, 1902, a storm that developed marked intensity over the Atlantic Ocean moved northeastward from the Caribbean Sea to the British Isles. Warnings were cabled well in advance of the storm to San Juan, Porto Rico, to Havana, Cuba, and to coast Weather Bureau stations from New Orleans, La., to Boston, Mass., to the observatory at Horta, Fayal, Azores, and to Lloyd's, London.

One of the most important storms of the year appeared on October 6, 1902, in the Gulf of Campeche, moved thence to the middle Gulf coast of the United States by the 10th, reached a position off the south New England coast by the morning of the 12th, and advanced over the Atlantic Ocean to a point near the north coast of Scotland by the 16th. Ample and timely warnings were issued to United States Gulf and Atlantic ports regarding the character and course of this storm.

During the late fall and winter months North Atlantic shipping interests were frequently advised regarding the approach and progress of the exceptionally severe storms of those seasons.



The first general frost of the season extended from the Northwestern States over the Lake region and central valleys, and as far south as Arkansas and northern parts of Mississippi, Alabama, and Georgia, from September 11 to 14, 1902. Timely warnings permitted protective measures in the districts visited by the frost of this period.

The first important cold wave of the season swept southward and eastward from the British Northwest Territory over the interior of the country from November 26 to 28, 1902, carrying the line of freezing temperature almost to the coast line of the Gulf of Mexico. Timely warnings were given to all interests that were subject to damage or loss by frost and cold.

The following comment was made by the New Orleans Times-Democrat of November 28, 1902, on the warnings issued for the Gulf district, the only section east of the Pacific coast States in which agricultural products were endangered by frost:

The warnings sent out Wednesday morning were timely for all parts of this extensive district. Freezing weather occurred over Arkansas, Oklahoma, and northwest Texas. Heavy frosts occurred over the interior of Texas, and frost occurred generally over southern Texas and all of Louisiana. Frost was in evidence in New Orleans, and on the outskirts was quite heavy. The warnings of these severe conditions were issued by the Weather Bureau well in advance, and all business interests were prepared for the frosts and freezing.

The following is an extract from the Galveston (Tex.) News of December 4, 1902, with regard to the cold wave warnings of the 3d:

Last winter the Weather Bureau saved many thousand dollars to the farmers and truck growers of south Texas by timely warnings of heavy freezes, and yesterday morning when the warnings were telegraphed and telephoned to points of interest no time was lost in getting the tender vegetation under cover. The Weather Bureau's notice was practically two days in advance, because the coldest period is expected to-night and early Friday morning. When Sugarland was communicated with the sugar mills were shut down at once and all hands took to the "tall cane fields," to use a common saying. It was reported that several hundred men were in the field cutting sugar cane and windrowing it an hour after the weather bulletin was received. The army of cutters was being rapidly reenforced, and it is expected that several hundred acres of cane will have been cut and stretched on the ground by to-night. A heavy freeze with the cane standing would play havoc and would mean the loss of perhaps thousands of dollars.

The following is an editorial from The Sugar Planters' Journal, New Orleans, La., of December 20, 1902:

An evidence of the esteem in which the forecasts issued by the United States Weather Bureau at New Orleans are held was shown by the sugar planters all over the State by their windrowing thousands of acres of cane on receiving warning of the late cold snap, when the temperature fell as low as the freezing point, and in some places even lower.

This faith in the prognostications of the "weather man" was largely brought about by the accurate forecast of the destructive freeze of last December, when the loss to the sugar industry of Louisiana figured, perhaps, upward of several millions of dollars. The exact loss by that terrible freeze will never be known. Had more planters windrowed promptly upon receiving warning last year from the Weather Bureau the loss would have been greatly curtailed. The accuracy of the forecasts as now issued to the sugar planter has had much to do with the growing belief in the efficacy and wisdom of windrowing cane when a cold snap is predicted as about to swoop down on us. Fortunately, these warnings are generally issued some twenty-four or thirty-six hours ahead of the freeze, thereby allowing of a considerable amount of cane being placed safe in the windrow before its advent. It is considered by many, though, as wisest not to run too great a risk of being caught with a large area of cane in the field, and we find numbers of planters disposed to windrow about the middle of December, freeze or no freeze, provided they have sufficient cane to put the end of the campaign to as late as the middle of January.

The Tampa (Fla.) Herald, of December 27, 1902, remarked as follows regarding the warnings:

"Heavy and damaging frost to-night" was the brief warning sent out over this section of the State yesterday by the local weather observer, but the warning, despite its brevity, was effective and doubtless saved thousands of dollars to the planters, especially those who own large "pineries," as the cold wave that struck the State was sufficient to greatly injure the "pines."

Mr. W. W. Fisher, president of the United Telephone Company, Bellefontaine, Ohio, under date of December 26, 1902, addressed the following letter to Mr. C. L. Lane, Weather Bureau displayman at Bellefontaine:

Our telephone company desires to express in writing its appreciation of the cold-wave warning given by you to our superintendent on Wednesday last. We have fifty stations in our system, which extends throughout this and adjoining counties, and this news was immediately telephoned to each station with instructions to circulate the information there. In our system are a great many farmer subscribers, and this news was given to each farmer. We take pleasure in telling you that it was appreciated a great deal more than can be expressed here. We shall be pleased indeed to communicate to our patrons throughout our system any like information that comes to you in your position as voluntary observer of the United States Weather Bureau in our city, and we shall always be glad to render you any assistance, at any time, within our power.

A notable feature of the weather of February, 1903, was that while a rapid succession of severe storms continued over the United States, the Atlantic, and northern Europe, the barometric pressure continued abnormally high over southern, and more especially southwestern, Europe. From the 23d, when the center of the last American storm of the month reached the region north of Scotland, until the 28th, barometric pressures were low over southwestern Europe, and the center of a barometric depression of exceptional strength remained almost stationary north of the British Isles. The steep barometric gradient of this apparently stationary disturbance extended over the Atlantic almost to the American coast, and caused, during the last five or six days of the month, a continuation of violent gales from Newfoundland to the western European coasts.

The first important storm of February occupied Nevada on the morning of the 1st, and reached the Gulf of St. Lawrence on the 5th. The heavy rains of the 3d, 4th, and 5th, accompanied by thawing, resulted in floods in the Allegheny and Monongahela rivers and tributaries. All interests about the headwaters of the Ohio likely to be affected by high water were kept informed by day and night of the stage of the rivers, and advices and warnings with regard to anticipated stages were issued hourly by the Pittsburg office of the Weather Bureau. On the 4th that office advised the public to prepare for high water, and predicted a stage of 24 feet on the gauge at Pittsburg by the 5th. A stage of 24 feet was reached at noon on the 5th. On the morning of the 5th, when the western storm referred to was central over the Canadian maritime provinces, the following message was cabled to Lloyd's, London:

Severe storm will move eastward from Newfoundland to-day.

This storm reached a position north of the British Isles on the 10th, and by the morning of the 11th had passed over the northern portion of the Scandinavian Peninsula, with central barometric pressure about 28.40 inches.

The second storm of the month appeared on the 6th over New Mexico, to which position it probably advanced from the extreme southern California coast. Moving rapidly eastward this disturbance reached the middle Gulf coast on the morning of the 7th, passed northeastward to Lake Erie by the morning of the 8th, and reached Nova Scotia by the morning of the 9th, with rapidly increasing strength. On the morning of the 7th the following message was telegraphed from Washington to Weather Bureau stations in northern Ohio, western and northern Pennsylvania, and New York:

Heavy snow indicated for to-night in northern Ohio, western Pennsylvania, western and northern New York.

Warning of heavy snow in northern Illinois and northern Indiana was sent from the Weather Bureau office at Chicago.

The snowfall of the 8th was particularly heavy in the central districts of New York, where railroad trains were delayed.

In connection with the cold wave of February 16 and 17, 1903, the Picayune, of New Orleans, on February 18, 1903, said:

The severest weather of the winter throughout the Southwest prevailed yesterday morning. Owing to the forecaster's timely notice and warning to planting interests, sugar, truck, and orange growers having been forewarned in ample time, there were taken the proper precautions for the freeze and severe injury was averted. This forecast having been implicitly believed by the agriculturists of the district, who had occasion last year to rely on Dr. Cline's accurate prediction, saved them many hundreds of thousands of dollars. When it is considered that such low temperatures do not occur in February more than once in eight or ten years, the successful forecasting thereof, in every instance of their occurrence, speaks much for the skill and efficiency of the Weather Bureau forecaster.

The following letter, dated February 21, 1903, was received by the Weather Bureau observer at San Antonio, Tex., from the president of the San Jose Truck Farm Company:

The daily weather forecasts, and particularly the cold-wave warnings of the recent cold snap, have been of inestimable value to us. It was only through careful attention to the forecasts from the Weather Bureau and promptly acting on the warnings that we have managed to bring through, without loss of a plant, our crop of 35 acres of tomatoes.

Gales of unusual severity prevailed on the North Atlantic coast of the United States during February 16 and 17, while in New England snow fell to the depth of 15 to 20 inches.

The Boston Globe of February 18 commented as follows regarding this storm:

The biggest storm that Boston has seen for at least five years ceased yesterday, although its effects will be felt for several days yet. The storm was heralded by the Weather Bureau Sunday night. This gave sea captains more than eighteen hours' notice and doubtless saved many vessels and lives.

The other Boston papers also made favorable mention of the storm warnings and forecasts.

The unprecedented floods in the lower Mississippi Valley in the spring of 1903 and the disastrous floods of May and June in the lower Mississippi and upper Mississippi valleys are discussed under the heading "Rivers and floods."

The quotations from the public press made in this report are but a few of the many favorable comments that reach this office. They are produced as impartial testimony to the high average verification of the important warnings of the Bureau and as unofficial evidence that the expenditure of one and a quarter million of dollars brings an adequate return to the commerce and industries of the country.



## WEATHER MAPS.

The Weather Bureau issues each morning, excepting Sundays and holidays, about 25,000 maps that present graphically and by text and tables the weather conditions throughout the United States and Canada at 8 a. m., seventy-fifth meridian time. About 50 per cent of the maps are prepared at 23 of the larger stations of the Bureau by what is known as the chalk-plate process; the others are prepared at 71 of the less important stations by the millio-graph, or wax-stencil process. All of the maps issued at stations are about 11 by 16 inches in size. The chalk-plate process of map making has proved satisfactory. By this process the mechanical part of map making can be expeditiously performed, and an unlimited number of maps can be issued. The millio-graph process, while fairly satisfactory as regards the character of the work that can be performed, admits only of a small edition of maps, and is, therefore, unsuited to the requirements of large stations.

Experimental work in preparing chalk-plate maps of a larger size than those now issued at the more important stations has been conducted with a view of meeting an increasing demand from all sections of the country for maps that contain more complete weather data than can be published on the small maps now issued. The result of this work has been a practical demonstration of the feasibility of making maps about 22 by 16 inches in size (corresponding in size and make-up to the map issued at the central office at Washington) that will contain reports from all Weather Bureau stations, and also present graphically by symbols, lines, and shadings the wind and weather, barometric pressure, temperature, and rainfall throughout the entire region of observation.

The demand upon the Weather Bureau for maps of this character comes from commercial, agricultural, marine, and other interests; from educational institutions, and the general public. It can be met by equipping 20 of the more important stations of the Bureau with outfits for issuing the large chalk-plate maps and transferring the present chalk-plate equipments to smaller stations, there to replace the millio-graph process.

The approximate cost of equipping 20 stations for the issue of large chalk-plate maps and 30 stations with the small chalk-plate map, including printing material and presses, stereotyping outfits, rent, power, and pay of printers, is \$110,000, of which \$40,000 is for assistance.

As the weather maps afford the only effective means possessed by the Weather Bureau for promptly placing before the public its daily observations and summaries, the improvement and extension of the maps along the lines indicated is urgently recommended. To carry out during the next fiscal year one-half of the plan outlined above it is recommended that \$35,000 be added to the appropriation for "general expenses" outside of Washington, and \$20,000 to the appropriation for salaries.

## SCIENCE AND RESEARCH.

## BAROMETRY.

The result of Prof. Frank H. Bigelow's discussion of the barometry observations that were made during the years from 1871 to 1900 have been incorporated in the Report of the Chief of the Weather Bureau, Vol. II, 1900-1901, "The barometry of the United States, Canada, and the West Indies." The data contained therein have been made the



standard for the Weather Bureau, and the portions pertaining to the several stations have been put in operation, so that the barometry system has been made as efficient as possible in conformity with the best scientific models.

The adopted station elevations will be used as points of reference by local and general surveys; the normals of pressure, temperature, and vapor tension will be valuable in all meteorological and climatological studies; the variations of the pressure with the months, and from year to year, will be used in studying the effects of solar radiation upon weather conditions generally, and especially in laying a basis for seasonal forecasts.

The reductions of pressure have been made by suitable tables from the stations to the sea-level plane, and the synchronous isobars are used in constructing the daily weather maps. Besides this reduction to sea level, reductions of pressure to the 3,500-foot plane have been made, which is at the average height of the plateau stations, and also to the 10,000-foot plane, which is located in the upper part of the ordinary cyclones and anticyclones. Daily reports of the pressures on these planes have been received by mail from the outlying States in the United States and Canada, and these mail reports are being used in forming charts on the higher levels, whereby the structure of storms can be suitably studied for the first time in the history of meteorology.

This preliminary study will be continued for one year before rendering a report on the value of these high-level charts in practical forecasting. At present the indications are that they will be more efficient than was anticipated, and they certainly open a new field of investigation of the utmost importance in furthering our knowledge of the circulation of the atmosphere. Professor Bigelow believes that they have for the first time shown us positively what is the true structure of storms, and that they point unmistakably to a theory which will supersede those heretofore published in meteorological literature. It should be noted that three independent researches have converged upon the same result and that they mutually confirm one another, namely:

- (1) The average circulation as derived from the auxiliary cloud maps used in the forecast division.

- (2) The theodolite and nephoscope observations made by the Weather Bureau in 1896-97.

- (3) The isobars constructed by the barometric reductions just mentioned.

These show that the general circulation and the local circulation merge into one another and form the observed cyclones and anticyclones; that the source of energy for the general circulation is the sun's radiation in the Tropics, and for the local disturbance the counterflow and underflow of low-level currents of different temperatures between the tropical and the polar zones. This result excludes three well-known theories: (1) The local overheating of the surface strata; (2) the latent heat of the condensation of the aqueous vapor; and, (3) the eddies attributed to difference of velocities of adjacent strata. Storms are actually more complicated than was supposed, and it will require some careful work to finish up the subject, but the prospect of obtaining a satisfactory outcome is now promising.

Besides this work on the mechanics of the local cyclones, the nepho-

scope observations made in the West Indies in the years 1899-1903 are being discussed by Professor Bigelow, who hopes to derive therefrom more definite results regarding the circulation of the air in the Tropics and in the formation of the trade winds.

The data are being collected for a report on temperatures and vapor tensions, with the view of ultimately constructing high-level isotherms and vapor lines in connection with the above-mentioned isobars.

This work has been the special field of Professor Bigelow. It is all highly important to the higher science of meteorology.

#### METEOROLOGICAL INVESTIGATIONS.

The Weather Bureau has also been carrying on for some years an investigation into the fundamental problems as to the true causes of the weather conditions in the United States, the ultimate purpose of which is to improve the forecasts issued for a day or two in advance, and if possible to discover some basis for a scientific forecast of the seasonal variations from year to year. Sufficient progress has been made in practical methods to justify a summary of the work already done, and especially to point out the steps which should be taken to secure to meteorology a positive advance as a science and as an art of commercial utility. The methods at present employed in making up the daily forecasts are substantially the same that were devised at the time the Government service was established in 1871. Every effort has been made to bring the system to perfection, and much labor has been devoted to the study of the sea-level charts upon which it is based to secure the best results in forecasting that are possible with that kind of data, namely, the isobars, isotherms, wind velocities and directions, and precipitation areas, as published on the daily weather maps. Yet, it has been impracticable to avoid a certain class of errors in reading these charts, though a sufficiently high average of correct forecasting has been maintained to justify the expense of the service; but it is apparent that much labor in research is justifiable where there is a fair promise of an ultimate improvement in successful forecasting. The mistakes in judging the immediate development of the sea-level maps consist usually in an error as to (1) the direction of the storm track, (2) the rapidity of its onward march, (3) the intensity of its action, and (4) the location of the accompanying rainfall areas. Therefore any improvement of the system of forecasting must have an especial regard to these four points.

#### STUDY OF CYCLONES AND ITS VALUE FOR DAILY FORECASTS.

Before mentioning the results of recent researches it is proper to enumerate the most important theories regarding the circulation of the atmosphere generally and locally in order to contrast them with the new theory.

**GENERAL CIRCULATION.**—Professor Ferrel's theory was practically undisputed by meteorologists until the cloud observations made by the Weather Bureau in 1896-97, and published in the Report of the Chief of the Weather Bureau for 1898-99, indicated that it must be greatly modified to match the true circulation of the atmosphere. The European and Asiatic observations made at the same time, the results

having been published by Hildebrandsson for the international committee in 1903, are in agreement on this point with those of the Weather Bureau. Ferrel reasoned as follows: The sun's radiation heats the air in the tropical zones, causes it to rise upward and then to flow poleward in the high strata, and return to the Tropics in the low strata near the surface. The rotation of the earth, whose atmosphere is thus heated, causes an eastward rapid drift in zones north of  $30^{\circ}$  latitude and a westward drift in the tropical zones.

Now, as a matter of fact, our cloud observations showed for the United States that in the upper strata there is no such northward current as Ferrel assumed to exist. The flow from the Tropics to the poles is not in the higher levels, but in the lower levels up to 3 or 4 miles elevation, and not above that height. There are strong currents of warm air which flow from the Tropics into the temperate zones at low levels, and there they meet the cold currents flowing southward from the polar regions. These counterflowing currents, which at the same time underflow the eastward drift in the upper strata, possess the thermal energy necessary to generate cyclones and anticyclones, and the natural function of these gyrating masses of air of different temperatures is to bring back to an equilibrium the thermal state of the atmosphere which is being continually disturbed by the sun's radiation falling upon the tropical zones.

LOCAL CIRCULATION.—There are three distinct theories which have been strongly advocated by students to explain the origin of cyclones and anticyclones: (1) The Ferrel vertical convection theory; (2) the German vertical convection theory; and, (3) the dynamic eddy theory. It is not practicable to describe these in detail, but the principal ideas are as follows:

(1) Ferrel conceived his local cyclone as similar to his general cyclone, and illustrated it by heating at the center of the lower surface a mass of water contained in a cylindrical vessel, turning it at the same time bodily about its vertical axis. This makes the water flow in certain *closed* curves, since it is the *same* mass of water in motion. We now know from recent observations that the air simply flows once through a cyclone, and that new masses of air are constantly involved, so that Ferrel's idea can not be true. For a central source of heat Ferrel accepted Espy's view, that the latent heat of condensation due to rainfall is the source of the vertical current. There are, however, many fully formed cyclones that are practically dry, so that the latent heat can not be more than a secondary source of energy in the production of storms, though it may intensify a given cyclone.

(2) The German vortex is much nearer to the facts of nature, because it is not limited to a fixed mass of air, but allows new air to stream through it. In this case we have a central part with a vertical velocity surrounded by currents flowing only in horizontal directions, and suddenly lifted on reaching the central core. In this vortex the central vertical velocity increases in proportion to the height, and it would become enormous in the upper strata. Recently discovered facts do not sustain these ideas very well, and they must be much modified. The German vortex theory, as well as the Ferrel vortex, has relied upon the latent heat of condensation for the central rising current, but there are several intractable difficulties which stand in the way of accepting either of these theories. Indeed, so strong have these objec-



tions appeared to some students that they have abandoned the convection theories depending on thermal energy, and have taken up the purely mechanical or dynamic theory of eddies.

(3) The eddy theory considers the cyclones as simply whirlpools produced by currents flowing past each other at different velocities, especially in the temperate zones, much as eddies are formed in a rapid stream of water. It is only necessary to note that cyclones form frequently and numerous in the Southern States, that is, in the midst of the high pressure belt, where there is no rapid motion east or west of any kind; that the adjacent strata in the temperate zones do not have sufficient differences of eastward velocity to stir up genuine eddies on a large scale; and that over Asia and the Pacific Ocean, where similar eastward velocities prevail, there are practically no cyclones as compared with the number in North America, the North Atlantic Ocean, and Europe.

Professor Bigelow has found the conditions of this complex problem generally satisfied by admitting the counterflow and underflow of currents of different temperatures at low elevations, such as have been deduced from our observations on the flow of the atmosphere, and from our new barometric reductions to the 3,500-foot plane and the 10,000-foot plane. It will be necessary to give more detailed attention to these results, as yet unpublished, except for one paper in the *Monthly Weather Review* in February, 1903. The importance of arriving at the correct structure of cyclones, or the configuration of the curves through which the air circulates in them, is so great that it has been discussed in three independent ways, which mutually sustain one another by coming to the same result.

(a) The first method consisted in taking the cloud maps used as auxiliaries in forecasting, selecting 40 or 50 maps in a series of years having the same region for the storm center, as the Lake region, and computing the resultant motions in all the minor areas of the cyclone. There was published in the cloud report a series of such resultant cyclones for the sea level, the cumulus cloud level, 1 to 2 miles high, and for the cirrus cloud level, 5 to 7 miles high.

(b) To carry out the second method, theodolite observations were made at Washington for one year, May, 1896, to May, 1897, and nephoscope observations were conducted simultaneously at 14 stations scattered quite regularly to the east of the Rocky Mountains, upon the cloud motions in nine different cloud levels from the surface of the ground up to the cirrus level, and in each of these the actual velocity was measured or found by computations. From these data a structure was obtained for the cyclone in agreement with that of the first method.

(c) Finally, the barometry observations taken in the United States since 1873 have been reduced to a homogeneous system, and all the necessary corrections have been applied to make the series from January 1 of that year up to the present time strictly comparable. From these data, and with the help of the temperature gradients found from the observations made during the kite ascensions of 1898 in the Mississippi Valley, together with the available European balloon ascensions, it was possible to construct normal maps of the pressure, temperature, and vapor tension on the sea-level plane, the 3,500-foot plane, and the 10,000-foot plane, for the twelve months of the year.

Also, reduction tables were constructed to facilitate finding the pres-



sure daily on these three planes at about 150 stations in the United States. The sea-level reductions have been used since January 1, 1902, in making the weather maps employed in forecast work and issued to the public at several centers. Since December 1, 1902, the reduced pressures on the 3,500-foot plane and the 10,000-foot plane have been sent to Washington on postal cards, whereby the maps on the higher planes are drawn for comparison with the sea-level charts. At the present writing Professor Bigelow has examined these maps for six months, with the following general conclusions:

(1) The high-level isobars give precisely the same configurations for the structure of cyclones and anticyclones as were obtained from the cloud charts and the direct instrumental observations, so that the barometry report, in the Report of the Chief of the Weather Bureau, 1900-1901, confirms the results of the cloud report.

(2) The great advantage pertaining to this isobar system is that the details are given on the upper levels in great abundance and variety, and they serve for studying these meteorological problems in many different aspects. It will be possible only by preparing a special report on the subject, which is now in process of construction, to give any idea of the new information contained in these high-level charts, and we hope to issue this report within the coming year.

(3) It may be stated in this place that the cyclones are formed by currents flowing into the temperate zones from either side in the low levels, that is, a mile or two above the ground, where, by the intermixing and the change of elevation which is induced by their difference of temperature, they cause the gyrations usually observed at the surface in the low and high pressure areas. If a warm current underflows a relatively cold current, the lower air rises, cools its vapor contents, and precipitates the same over wide areas. Precipitation is due to the lifting of the air in part by dynamic vortices where the isobars are closed curves and in part by underflowing warm, moist sheets of air, which are not vortices. There are many examples of the fact that the warm and moist southerly currents in the 3,500-foot level underflow the cold currents drifting eastward in the 10,000-foot level and precipitate their contents of moisture over large areas. These upper-level maps, at least in the six months from November to April, inclusive, most efficiently supplement the rainfall forecast indicated by the usual sea-level maps, and in many instances they clearly show the rain area for the next thirty-six hours, while the sea-level weather map fails to give such information with the necessary distinctness. This conclusion is very promising, as indicating a probable improvement in the rain forecasts in the winter months. In the summer the system is different from that of the winter, and it is not possible at present to make any statement regarding the efficiency in the warm season.

(4) It happens that on the upper levels the direction of the storm track may often be shown by the trend of the isobars on the 10,000-foot plane. If these slope to the northeast the cyclone usually moves in that direction, if to the southeast it still follows them. Thus, instead of conjecturing in which of two possible paths the storm center will advance, it is practicable to select the one it usually will follow by reference to the upper isobars. Furthermore, the density of the isobars on the 10,000-foot plane, that is, the closeness with

which they are packed together, is a very strong indication of the relative velocity with which the cyclone will move. If they are close together it will advance rapidly; if they are wide apart or straggling it will move slowly. The difference in velocity between the cyclones of January and May, for example, is a good illustration of this law, and it is likely that a suitable study of this subject will enable the forecaster to judge much more accurately of the storm's progress than has been possible from the sea-level charts alone.

(5) The penetrating power of cyclones and anticyclones into the higher levels is distinctly shown by the changing configuration of the isobars on the three successive planes. The number of closed isobars, within which a purely vortex motion with a vertical component can alone exist, diminishes from the surface upward, and they finally change into sinuous curves before they ultimately disappear in the swiftly moving eastward drift of the high levels. It has been shown that in the case of hurricanes the penetration reaches powerfully to the cirrus level, 6 miles from the surface, and with precisely the same typical configuration for the circulation. There are many other interesting features which are contained in this series of charts, but it will be proper to reserve them for further study before expressing conclusions regarding them. Enough has already been discovered to inspire a feeling of confidence that the high-level charts will efficiently supplement the sea-level charts, and in some cases supersede them in forecasting usefulness. It is possible to telegraph the data needed for constructing them by adding one word to the forecast code, such as a word of the barometer-temperature type, and a single clerk can draw the two sets of upper isobars while the usual sea-level charts are being made. It will require considerable study on the part of the forecast division to thoroughly digest the new material and overcome a feeling of strangeness. Thus, in cold waves we see on the sea-level plane a very high pressure, but on the 10,000-foot plane a distinct low pressure over it. The new charts also will dispel many erroneous conceptions now held by the public regarding the true theory of storms.

#### THE PROBLEM OF SEASONAL FORECASTS FOR A YEAR.

It is a very difficult piece of science that is involved in the attempt to place the forecasts of the seasons for a year in advance upon a reliable basis, because it will be necessary to take account of several interrelated processes in nature, which depend upon the circulation of the atmosphere of the sun and of the earth. The science of meteorology is not to be confined to the atmosphere of the earth; because the changes in the action of the atmosphere of the sun precede the variations in the earth's air, which finally culminate in a certain type of season. Thus, wet and dry seasons, warm and cold summers and winters, and all the other climatic differences first depend upon the persistence of special high and low areas of pressure in one locality or another; these go back to the circulation of the great currents in the atmosphere, which seem to surge back and forth from one side of the earth to the other, or from the oceans to the continents; finally, these currents are probably due to the solar radiation, which itself changes with the output of energy from the interior of the sun. Thus, meteorology is really a very closely allied but difficult branch of solar



physics, and it ought to be studied with the aid of a fully equipped observatory devoted especially to such researches. On the sun we count up the number of hydrogen flames or prominences seen on the edge of the disk from day to day, and, from a discussion of the thirty years' record in hand, they are known to vary strongly from year to year. Similarly, the faculae and spots have their fluctuations in synchronous cycles, and these have been studied for many years. Furthermore, the sun emits energy in the form of radiant light and invisible heat, and by means of suitable spectrum observations the variable amount of this light, and especially the invisible heat, can be registered from day to day and from year to year. The result of these records is to indicate that the sun is in fact a great, variable star, and that terrestrial weather changes in close synchronism with it. There is yet another register of the energy emitted by the sun to be found in the variations of the earth's electrical and magnetic fields, which is perhaps the most sensitive of all, and certainly the most accessible to our measures. The newly discovered action of ions in the atmospheres of the sun and the earth, respectively, which are now believed to be the basis of the electrical and magnetic manifestations, is affording much information upon this obscure subject, and it is full of promise in practical investigations. Langley has announced that the invisible radiant heat energy, as measured in his holographs, varies from season to season and from year to year. The passage of an eclipse shadow through the atmosphere changes the atmospheric magnetism and electricity in the same way that day and night modify them—by cutting out the sun's rays. In short, the entire field of cosmical processes forms a complex problem which especially concerns the meteorologist, and by him should be studied out for the benefit of mankind, whose life and happiness depend so largely upon the weather.

MOUNT WEATHER RESEARCH OBSERVATORY.

The Weather Bureau is so far convinced of the importance of finding out the laws of this cosmical physics, by which alone the problem can be conclusively solved, that it has been thought proper to found a research observatory at Mount Weather, on the crest of the Blue Ridge Mountains, about 6 miles from Bluemont, Va., and equip it suitably for these investigations. Professor Bigelow has recently been placed in charge of supervising the plans for its construction and development upon the best modern principles. It is evident that such an institution, having its beginning in the early years of the twentieth century, will have an increased usefulness as the years go by, if it is organized according to the demands of the best science. It will require fine instruments and able students if it is to command the respect of the scientific world. The subject of solar physics has already grown to such proportions that the British Association for the Advancement of Science has set off a solar physics section from astronomy and mathematics; the solar physics observatory at South Kensington, under the able directorship of Sir Norman Lockyer, is putting forth valuable results; the solar observations by the Italians for the past thirty years have become invaluable as a basis for these studies; the observatory at Kalocsa, Hungary, and that at Zurich are known to all students for their important publications. Less directly, several of the great astronomical

observatories are deriving some of their most valuable discoveries in astrophysics, which is simply another name for stellar meteorology. Thus Potsdam, Paris, Lick, Yerkes, Harvard, and other institutions are working zealously along these lines and filling out the realm of human knowledge in a fashion undreamed of a generation ago. It may be asked why, with all this wealth of material being secured in other places, it should be important for the Weather Bureau to enter upon these studies as well. The answer is simple. These observatories, for one thing, specialize along certain lines, and it is evident that there should be at least one institution in the United States where these results are brought together and studied side by side, so that their combined result at a given time can be worked out harmoniously and correlated with the prevailing weather conditions. Furthermore, the publications of these several observatories are issued from the press as much as two to four years after the observations are actually made, so that it is obvious that these late reports can have little value in practical forecasting. We have no intention to enter upon the advanced research problems which rightly belong to specialists, but rather to adapt to the uses of the meteorologist and the forecaster such portions of the well-known types of observatories as seem to be practicable for the immediate uses of the Weather Bureau.

Specifically, the plan in mind contemplates the development of an observatory as indicated in the following statement:

(1) An observatory building is in process of erection at Mount Weather, which is well adapted as a school of instruction and for making observations of the ordinary kind with the common meteorological instruments, barometers, thermometers, wind and rain gauges, nephoscopes, theodolites, and actinometers. The first floor is for administration, the second for living quarters, the third for laboratories, and the roof for observing.

(2) Plans are being prepared for a plant adapted to generate large quantities of hydrogen, for balloon ascensions, including a shop for the construction of balloons and kites. The ascensions will be limited to about 4 miles in height, our immediate purpose being to measure the temperatures and thermal gradients, which will enable us to construct daily isothermal charts on the two upper planes already described, so as to provide isotherms as well as isobars on the high levels. It is proposed to make a complete series of ascensions first at Mount Weather, and afterwards in different portions of the United States, in order to observe the temperature conditions in all classes of cyclones and anticyclones. We may attempt some high ascensions, up to 10 or 12 miles from the ground, when our experience and other conditions warrant, but, since storm movements are practically limited to the strata within 4 miles of the ground, the first group of ascensions will be to moderate elevations.

(3) It seems important to install a high-grade bolometer for measuring the invisible solar radiation, which is thought by some students to be largely responsible for the actual temperature of the upper atmosphere. Also, a first-class spectro-heliograph is required for keeping a record of the solar prominences, faculae, and spots prevailing at the time of making our weather forecasts. These two instruments are the essentials of an efficient solar physics observatory, and would require the services of an able student of physics to bring out the best results and discuss them efficiently in suitable reports.



(4) These records should evidently be supplemented by an observatory equipped with modern instruments for observations in atmospheric electricity and in magnetism, and we note that a number of valuable new instruments have been invented in recent years which we can use. The special subject of this research is the behavior of ions in the atmosphere as forerunners of weather conditions.

Generally, the idea is to bring together for study under one direction the most valuable and practicable observations having a direct bearing on the higher meteorology, which is now engaging the attention of many able physicists and astronomers. In this field are found the best examples of physical and mathematical problems, because it is nature's great laboratory. The atmospheric conditions at Mount Weather are superb, the site being 1,800 feet above the sea level, on a ridge overlooking the wide Shenandoah Valley to the west and the plains of Virginia to the east. An equipment at that place, such as is contemplated, will induce a great scientific activity and generate an intellectual atmosphere highly favorable to the best scholarship. The assistants in charge of the various lines of work will form a strong corps of teachers, who will instruct a new generation of men in the great problems of meteorology, which are destined to occupy the attention of mankind in an increasing ratio with the lapse of time. If the equipment be made up of the very best instruments and able students secured to use them, and especially if patience be manifested in allowing the data to accumulate and be studied in the proper way, an improvement in forecasting for America should be assured. This institution is to be planned for continuous work in the future, and it is not supposed that its effect on forecasting will be immediately manifest, because of the difficulty and complexity of the problems involved. One thing is certain, that the founding of such a research institution is the true scientific way to provide for the future, in assurance that the natural difficulties will finally yield to human persistency and intelligence.

#### PYRHELIOMETRIC MEASUREMENTS.

Mr. H. H. Kimball was sent to Asheville, N. C., with an Angström pyrheliometer. Under arrangements made by Professor Abbe, he took observations at stated hours each day from November 10, 1902, until March 26, 1903, at Asheville and Black Mountain, N. C. The observations were carried out with faithfulness, and the report, including a complete tabulation of the observations and reductions, has been rendered by Mr. Kimball. The observations made in 1901-1902, with a similar instrument, by Messrs. T. H. Davis and Robinson Pierce, jr., under the general direction of Prof. Carl Barus, at Providence, R. I., have also been submitted in a report by Mr. Davis. The two memoirs containing the work done at Providence and Asheville are recommended for publication in a separate bulletin, as they are too voluminous for the Monthly Weather Review. The solar radiation, as measured by this apparatus, is that which is actually received by every object at the earth's surface; the datum is directly applicable to problems in agriculture as well as to meteorology, and an effort will be made to explain its usefulness in an early number of the Monthly Weather Review. The actual amount of solar energy received at the outer limit of the atmosphere can also be obtained from this observed datum after we have learned how to interpret it by the study of the bolometric work that is carried on professionally by Professor Langley.

## POLARISCOPIC OBSERVATIONS.

In connection with the pyrheliometer, Mr. Kimball maintained a series of observations with the Pickering polarimeter, loaned by the observatory of Harvard College. The blue color of the sky and the polarization of the light depend alike on the fact that the atmosphere is a mechanical mixture of several gases and is loaded with vapor, haze, and dry dust. The polariscope gives us a basis for calculating the relative quantity of these impurities. Professor Abbe is of the opinion that Mr. Kimball's work may establish a connection between the polarization and the atmospheric absorption. The observations were found to indicate a decided diminution in the heat received from the sun during the months of January, February, and March, 1903, a fact that he was able to announce even before the publication of a similar observation made at Lausanne, Switzerland, by H. Dufour.

## TELEGRAPH DIVISION.

Our relations with the principal telegraph companies transacting the steadily increasing telegraph business of this Bureau have, in the main, continued satisfactory. Complaints of delays and other faults in the transmission or delivery of telegrams have, as a rule, received prompt attention and corrective action. Special acknowledgment in this direction is due to the local managers of the two principal telegraph companies in this city, whose unvarying zeal and courtesy have contributed much toward the prompt investigation of complaints, and the application of corrective measures where called for.

The total mileage of telegraph and telephone lines controlled by this Bureau was increased from 367 miles, at the date of last report, to 421 miles, by the construction and equipment of the following new sections:

(1) From Pacific City (Fort Canby), Wash., to North Head, Wash., 2 miles; completed August 1, 1902. This section connects the observation and storm-warning display station at North Head with the general telegraph system, and its value may be judged by the following extract from an editorial in the Portland (Oreg.) Oregonian of November 11, 1902, viz:

With the exception of the light-house service along the Oregon and Washington coasts, no greater aid to shipping bound for the Columbia River has ever been extended than by the recent establishment of a reporting station at North Head. \* \* \* The work of the Weather Bureau in this direction has been of great benefit to the agricultural and shipping interests of this district, but no branch of the service has shown its value more effectively than has the reporting station at the mouth of the Columbia River.

Vessel and weather reports are now telephoned direct from North Head to Portland, Oreg., for distribution.

(2) Nine miles of submarine cable from Key West, Fla., to the office of the newly established vessel-reporting and storm-warning display station on Sand Key Island, Florida. This connection was completed on February 26, 1903, and serves the important purpose of reporting to the maritime exchanges at New Orleans and other points the passing of vessels to or from Gulf ports, and the occurrence of any marine casualties in the vicinity; also for the display of storm warnings at critical seasons.

(3) A submarine cable from Point Reyes Light, California, to Southeast Farallone Island, California,  $23\frac{1}{2}$  miles in length, with about  $3\frac{1}{2}$

miles of land line. This cable was successfully laid and put into operation on April 14, 1903, for observation and vessel-reporting purposes, connecting at Point Reyes with the old line to San Francisco; but only twelve days later it was fouled by the anchor of the steamer *South Portland* and cut in two by the captain's orders, who claims such action to have been necessary to save his vessel. This occurred off Drakes Bay, about 1 mile from the cable landing at Point Reyes. The cable has since been recovered and repaired.

(4) A two-wire land line from Bluemont, Va., to the observatory now under construction on Mount Weather, Virginia, a distance of about 6 miles. This line was completed on May 8, 1903.

(5) Eight miles of submarine cable and 2 miles of land line from Glen Haven, Mich., to the newly-established storm-warning display station on South Manitou Island, Lake Michigan. This work was done under the personal direction of Mr. J. H. Robinson, superintendent of telegraph, who also supervised the erection of a steel storm-warning tower on the island. The cable was laid on May 9, 1903, and the station put into operation a few days later.

In connection with the South Manitou Island line, it should be mentioned that the employees of the light-house and life-saving services and other residents are very desirous of having this Bureau extend its cable line from South Manitou to North Manitou Island. While on the ground, Mr. Robinson made inquiry as to the benefit such a line would be to lake navigation, and learned that it would be useful in reporting and conveying orders to vessels that seek the North Manitou harbor, and that the island would also be a valuable point for the display of storm warnings. By utilizing the spare cable stored at Charlevoix the connection could be made and a steel tower erected on North Manitou for \$2,000 or less. It is therefore recommended that the next Congress be asked for an appropriation of \$2,000 for this purpose.

Telegraphic connection with Tatoosh Island, Washington, was reestablished during November, 1902, by means of a steel span wire, in lieu of the old submarine cable that failed in 1898; but the extraordinary difficulties encountered in the construction and maintenance of a land line to Cape Flattery, which for the past twenty years have rendered telegraphic communication with this important outpost exceedingly precarious, in spite of our best efforts, call for different methods of meeting the urgent demands for regular, uninterrupted weather and vessel reports from Tatoosh Island. An all-cable line from Port Angeles to Tatoosh Island offers the only practical solution of the problem. This, together with a cable from Flavel, Oreg., to Fort Canby, Wash., which is necessary for the betterment of the North Head weather and vessel reporting service, calls for an appropriation of \$90,000. It is recommended Congress be asked to allow \$15,000 with which to lay the Flavel-Canby part next year.

An additional appropriation of \$10,000 is recommended for the much-needed reconstruction of the important Hatteras line, including an extension of the same to Roanoke Island.

Action to equip the Point Reyes-San Francisco line with hard-drawn copper wire, in lieu of the old iron wire now in use, will be taken during the present year.

An attempt was made during last August to recover and repair the old Signal Service cable from Narragansett, R. I., to Block Island, which had been transferred to this Bureau. The cable, however, was



found to be practically worthless for further use, and the attempt had to be abandoned. The Weather Bureau cable to Block Island, laid in 1886, became defective in November of 1902. In making repairs it was discovered that this cable also was in a very bad condition and liable to fail entirely at any time. Congress, therefore, granted an appropriation last winter for a new 3-conductor cable, which will be laid during the present summer.

The great demand for additional Weather Bureau reports from many important classes of industry renders it advisable to request an addition to the present appropriation for "general expenses" of \$50,000, to be used in the distribution of weather observations, warnings, and forecasts by telegraph.

The total cash receipts of the Weather Bureau lines that are authorized to carry commercial (paid) business amounted during the year to \$5,288.38, of which amount \$2,687.58 was for "this line" (U. S.) and \$2,600.80 for "other line" tolls.

#### RIVER AND FLOOD SERVICE.

The work of the river and flood service, owing to the recent numerous and disastrous floods, has of necessity been a very prominent feature of the year. Several of the floods were the greatest of which there is authentic record, and were remarkable both for their wide extent and destructive character. In no instance was the coming of a dangerous flood unheralded. The warnings were uniform, prompt, and timely, and in the main remarkably accurate. The forecasts of the great floods of March, April, and June, 1903, afford noteworthy examples of the efficiency the river and flood service has attained, and are later made the subject of more extended mention. The following extract from an editorial in the New Orleans Times-Democrat of April 12, 1903, testifies to the value of the work:

We have been placed this year under another obligation to the Weather Bureau for its high-water news and predictions. It has kept the people of the lower Mississippi well informed of what they may expect in the way of high water, and its predictions have been subsequently verified by the facts. \* \* \*

It has predicted within a fraction of a foot the height the river would reach at various points and been very close to the date of maximum high water. \* \* \*

The day that the high water would reach New Orleans was stated with remarkable accuracy, for it was between three and four weeks after this warning that the wave crest reached here.

That the warning had a good effect, like that of an approaching freeze, none can doubt. It let the levee boards, planters, and public generally know what to expect in the way of high water and warned them to prepare accordingly; and they did prepare, raising the levees to the height sufficient to withstand the flood which the Weather Bureau warned us was coming. In this way, therefore, it contributed not a little to the energetic and generally successful campaign against the flood carried on this year.

The importance of the river service to the transportation interests of the Ohio River has been dwelt upon at various times. It is only necessary now to say that upon the efficiency of the one largely depends the prosperity of the other, and that the Weather Bureau has contributed much to the latter by maintaining in its river forecasts a high degree of accuracy, both during flood and the almost equally important low-water periods. These remarks apply with equal force to the remaining river districts, where very successful work has been somewhat overshadowed by the floods in the three great interior rivers.

The best recommendation that can be given work of this character



is a demand for the broadening of its field of operations and the extension of its benefits to localities not yet favored. Such demands have been constant and persistent, yet lack of the necessary funds has rendered it impossible to meet more than a small percentage of them. In several instances the limitations placed upon the work by lack of funds have seriously handicapped its efficiency and thereby caused loss of lives and property that might otherwise have been saved. The recent flood in the Kansas River was an unfortunate, yet none the less instructive, case. Had the Weather Bureau been able to maintain an adequate river service over this district it is practically certain that more accurate forecasts of the coming flood could have been issued and many lives and much valuable property saved as a result thereof.

It has been found to be practically impossible in recent years to obtain even moderately accurate estimates of the property saved through flood warnings. Formerly the warnings, owing to their very general nature, did not command the attention that the later and more specific ones compel, and interests were easily centered upon any marked benefits. But in these days the many and diverse interests that are more or less concerned with river stages have come to look upon the river forecasts of the Weather Bureau, both daily and special, as a legitimate and necessary portion of their business, an always available, if not a tangible, asset. It is impossible to make a record in dollars and cents of the benefits derived. However, general estimates can be made.

The great floods of the year were those of the Red River in November and December, the Ohio and lower Mississippi in March and April, and the lower Missouri and upper Mississippi and their tributaries in May and June. The first overflowed a territory in southwestern Arkansas and northwestern Louisiana, approximating 200 square miles in extent, and the property loss amounted to over \$500,000. This flood began about November 26 and continued throughout the following month. On November 23 the central office at Washington advised that "all necessary precautions should be taken for the removal of stock and property liable to be damaged by flood." These warnings were thereafter repeated daily, gradually becoming more specific as to time and height of the crest stage expected, until all danger had passed. The warnings were issued from seven to fourteen days in advance of the floods, and the crest stages in various localities were correctly forecast to within a small fraction of a foot. Mr. H. Hawkins, secretary of the Shreveport (La.) Board of Trade, wrote as follows:

The flood warnings sent out by the Weather Bureau before and during the overflow were so accurate and timely that all had ample time to protect themselves. In consequence of said warnings there was no loss of live stock and practically no loss of movable property. We have no data from which to compute the actual value of property threatened from the overflow, but it runs into the hundreds of thousands. Certainly the Weather Bureau did wonderful work.

This is but one of the many commendatory letters and press notices relative to this flood that were received.

The flood of March and April in the lower Mississippi River was the greatest in the recorded history of that section, and its culmination was awaited with feelings of deepest apprehension and concern. Although the aggregate volume of water was less than in the great flood of 1897, yet the extension of existing levees and the building of

new ones had still more restricted the natural channels, and the outcome of the new conditions was difficult to forecast. The test of actual experience was necessary. Despite these difficulties the warnings of the Weather Bureau were characterized by an almost absolute accuracy, and were issued from four days to four weeks in advance. With stages of water higher than ever before known, and with the prevailing uncertainty as to the effects of the new levees, the maximum difference between the forecasted stages and those actually recorded was only *three-tenths of a foot*, that being at New Orleans, where four weeks' notice had been given of the coming flood crest. The forecasts, however, were conditioned upon the levees remaining intact, and had they not broken in a few places even this difference, slight though it was, would probably not have occurred. The following table shows in a concise manner the stages forecast and those actually reached:

*Forecasts of lower Mississippi River flood and stages actually reached.*

Stations.	Forecast stage.	Actual stage.
	<i>Fect.</i>	<i>Fect.</i>
Cairo.....	50.5 to 51	50.6
Memphis.....	40	40.1
Helena.....	51	51
Arkansas City.....	53	53
Greenville.....	49	49.1
Vicksburg.....	52	51.8
New Orleans.....	21	20.4 to 20.7

Owing to the timely issue and effective distribution of the flood warnings the actual losses, beyond the inconvenience and delay caused by the overflowing of plantation lands, were comparatively small. All portable property was removed to places of safety and every possible precaution taken to protect that which could not be moved.

The floods of late May and early June, 1903, in the upper Mississippi, the lower Missouri, and the Kansas rivers were by far the most destructive, and with the exception of that of 1844, the greatest ever experienced in these localities. The warnings for the upper Mississippi were equally as accurate as those for the previous flood in the lower river. Ample time was afforded to everyone to make all preparations that might be necessary, and if some delayed until too late, their failure to act more promptly certainly can not be attributed to lack of emphatic and accurate warnings. At St. Louis, on June 5, one week or more after the flood warnings were begun, a special warning was issued that in about four days a stage of water in the neighborhood of 38 feet might be expected, the gauge reading at that time being 33.5 feet. On June 10 the water reached the height of *exactly* 38 feet and then began to recede. The floods in the Kansas River and in the Missouri in the vicinity of Kansas City could be forecast only in a general way, owing to the fact that no river service was maintained on the Kansas River, it having heretofore been found impossible to obtain sufficient funds for that purpose. The warnings issued stated that serious floods were probable, higher than had occurred for twenty years or more, but no definite forecasts could be made on account of lack of information of any description from points above the threatened districts. Had the Weather Bureau possessed an adequate river service within the State of Kansas during the recent flood, there is not the slightest

doubt that, while some lives might have been lost, others that were lost would have been saved by the warnings that could have been issued, and property to the value of hundreds of thousands of dollars rescued from the general ruin. It is strongly urged that Congress provide the necessary funds for the river service so greatly needed in Kansas and many other localities.

The demands for the extension of the river and flood service are utterly beyond the ability of the Bureau to supply. The majority of these demands are necessary for the well-being of the agricultural and commercial interests of the country, and the cost thereof would be comparatively insignificant. A new service should be at once inaugurated on the Kansas and its tributaries, on the Delaware, and in other localities, and additional stations supplied to many of the already existing districts. The telegraph service should also be extended in order that the daily reports, so necessary in many localities for accurate forecasting, may be furnished the various river centers.

The work of the service should also be broadened so as to embrace other and very necessary coordinate branches. The volume of water in the rivers corresponding to given stages in feet from the lowest water level to the highest flood plane should be measured. Information of this character affords a truer index of the real conditions than do the ordinary expressions in feet, which are at best the measured height of the water above arbitrarily assumed points, and are used chiefly because they are the most convenient vehicle for the conveyance of information to the general public. During recent years no connected series of discharge observations has been made in the large rivers of the country. An opportunity for doing a great service was lost through want of money during the spring floods of 1903, and it is hoped that another instance will not find us unprepared.

Another important field as yet imperfectly developed, but one of first importance to the student of river régime, is that of the connection of rain and snowfall with the varying stages of the rivers. The relations between the two are subject to so many intricate and ever-changing conditions of climate and topography that regular daily observations at a large number of places are absolutely essential if the best results are to be obtained. The winter snows in the mountain are often the controlling factors in our early spring floods, and if they are to be properly reported numerous stations of observation must be provided. Of equal importance are reports of heavy rainfalls along the headwaters of the various streams. For this work a large number of special rainfall stations are necessary.

The work of the river and flood service during the past year speaks for itself. Its excellent work, while greatly handicapped by reason of enforced limitations, is but an indication of what can be done if proper facilities are provided. The value of property saved through flood warnings of this year alone would more than provide for the needs of this service for a century to come, and I can not too strongly recommend that funds amply sufficient for the work be provided by Congress.

I am strongly of the opinion that the time has come when the river and flood service should be raised from its position as a part of a division and given the rank of a division, with such a complement of officials and clerks and such an increase in the funds allotted to its purposes as will enable it to still further perfect and extend the river and flood work so as to meet the needs of agriculture and commerce. The new



division, if created, should, as is now the case, be closely affiliated with the forecast division, and the official in charge, in so far as the issuing of flood warnings is concerned, remain under the general supervision of the professor in charge of the forecast division. I, therefore, have the honor to recommend that Congress be asked to appropriate for one additional professor, at \$3,000; one clerk, at \$1,800; one clerk, at \$1,200; one clerk, at \$1,000, and one copyist, at \$840. But \$17,000 is now spent for the pay of special river and rainfall observers and for the building of river gauges, and there are no measurements made of the sectional discharge of rivers. In order to extend the river and flood service, as hereinbefore outlined, I would also recommend that Congress be asked to increase the amount allowed for "general expenses" of the Weather Bureau outside of Washington by \$30,000. This additional amount will enable the Weather Bureau to do a splendid service for the interior commerce of our country.

The plan recommended would give to the chief forecaster of the Bureau \$3,000, and the \$2,500 professorship now held by him would be given to the chief of the new river and flood division, and one district forecaster at \$2,000 would be dispensed with. The officials referred to are men of high scientific attainments; they have seen many years of arduous service and study; neither of them has been engaged in the work for less than twenty years, and they are in the front rank of their profession. They are the chief forecasters of the Weather Bureau, and upon the character of their work must rest, in great measure, the value of the weather service. Their responsibilities are tremendous. At times the balance between life and death hangs upon their judgment, to say nothing of the saving or loss of millions of property. The warnings of a single storm moving up the Atlantic seaboard save hundreds of lives and from \$3,000,000 to \$5,000,000 of property during each storm, and there are a number of these storms each year. Since so much depends upon the skill and judgment of these men, it would certainly seem a wise economy to pay them a fair salary for their work—one even larger than recommended.

The chief of the proposed river and flood division will be charged with the supervision and proper conduct of the river service of the entire country, which even in its present partially incomplete state maintains over 300 river and rainfall stations. Losses by a single flood, such as the Kansas River flood of 1903, where no service is maintained on account of lack of the necessary funds, amount to more than the entire expenses of the river and flood service would amount to for a generation; and, conversely, the value of property saved by flood warnings where adequate service is maintained, such as that on the Ohio and Mississippi rivers during the spring of 1903, amounts to as much or more. These instances of the value and usefulness of this service are by no means isolated ones, but are repeated in greater or less degree several times annually. In the spring of 1897 the value of property saved during the Mississippi River flood as a result of the Weather Bureau warnings amounted, according to competent authority, to over \$15,000,000, and during the present year even these enormous figures were exceeded.

No one can doubt the tremendous importance of this work or belittle its effect upon the economic progress and development of the country. The watershed of the Mississippi River alone comprises two-fifths of the total area of the United States proper, within its confines dwell



more than 40 per cent of our population, and the great bulk of our staple crops are grown here. It is easy to perceive, therefore, that whatever affects the well being of this vast area will be reflected, now for good and now for evil, throughout our entire domain. To properly conduct a service of this character demands ability, both scientific and executive, of a high order. It is a work that requires many years of education and study, a life work in reality, and it is not fair to expect that a capable man should continue in it with the extremely small salary of \$2,000 a year, a compensation much smaller than that given to many other Government officials whose duties are much less arduous and whose responsibility for each day ends with the close thereof.

#### CLIMATE AND CROP DIVISION.

The climate and crop division has charge of the climate and crop service of the Weather Bureau, and of the distribution of its daily forecasts and special warnings. During the year ended June 30, 1903, its work was along established lines, no new feature having been added.

In the climate and crop work more than 3,300 voluntary observers and nearly 14,000 crop correspondents furnished meteorological observations and weather and crop reports that are used in the compilation of the monthly climatic reports and weekly climate and crop bulletins of the various sections, while about 300 paid stations of the corn, wheat, cotton, sugar, rice, and fruit services render daily telegraphic reports to designated centers from which daily bulletins are issued during the crop-growing season.

In the dissemination of forecasts through the various means employed an average daily issue of about 200,000 weather forecast bulletins is accomplished. In the preceding year it was through the rural free-delivery service of the Post-Office Department that the greatest increase in forecast distribution was effected, but on account of lack of funds it was not possible to further extend the distribution through this very effective means of reaching the farmers. A large and very prompt dissemination has, however, been accomplished, without cost to the Bureau, through the farmers' telephone exchanges.

For a number of years past an extensive distribution of weather forecasts has been accomplished through the cooperation of postmasters supplied with logotype and stamping outfits with which the brief weather messages are printed upon postal cards for mailing to outlying towns. While this system has served a most useful purpose, and will continue to prove valuable, urgent need has been felt for more rapid means of printing the forecasts.

Through the courtesy of the Director of the Census a sufficient number of copies of volumes containing agricultural statistics of the Twelfth Census was procured to supply each section center with a set consisting of Part I, Vol. V, and Part II, Vol. VI. The information contained in these volumes has been used to great advantage at the central office in determining the relative importance of the several States in the production of the various crops, and will prove valuable to the section centers in the study of climate and crop problems.

#### NATIONAL CLIMATE AND CROP BULLETIN.

The National Climate and Crop Bulletin has been issued in the usual form, with charts showing the current temperature and precipitation,

extremes of temperatures, and departures from normal of both temperature and precipitation. In this bulletin the current meteorological conditions are discussed in their relation to crop growth from the beginning to the end of the crop season. So expeditiously are the reports of crop conditions and meteorological observations collected and utilized that within twenty-eight hours after the close of the week ending 8 a. m. on Monday, there is given to the public in this bulletin a graphic presentation of the temperature and rainfall conditions, together with a general summary of the weather and crop conditions for the United States, supplemented by a condensed summary for each and every State. In the preparation of the temperature and precipitation charts accompanying the National Climate and Crop Bulletin telegraphic data from more than 450 stations are used. The effect on the markets of the information contained in this bulletin is so decided that in order to place it before the public in an impartial manner it is withheld until 12 noon on the day of issue (Tuesday), when the complete report is equitably and gratuitously distributed to all desiring it. It is doubtful whether any class of information receives a wider dissemination through the daily and weekly newspapers and agricultural journals than the text matter of the National Climate and Crop Bulletin. The press associations and a large number of the more important newspapers of the country with representatives in this city are served with the bulletin as soon as the hour for making the information public arrives.

In order to more fully meet the need of the cotton interests, an abridged form of the National Climate and Crop Bulletin, entitled "Cotton Region Climate and Crop Bulletin," is issued at New Orleans. This publication contains summaries of the climate and crop conditions prevailing in the States of the cotton belt, duplicates of which are published simultaneously in the National Climate and Crop Bulletin.

#### SECTION PUBLICATIONS.

The monthly climatic reports and the weekly climate and crop bulletins have been issued in conformity with the standard models adopted in 1896. In their present form they so satisfactorily meet the needs for which they are intended that no change seems advisable. The demand for both the monthly climatic reports and the weekly climate and crop bulletins, as well as for the daily bulletins of the corn, wheat, cotton, sugar, rice, and fruit services, is constantly increasing. So numerous have been the calls for the monthly climatic reports of previous years that the editions of very many sections have been exhausted, notwithstanding the fact that the section directors have been instructed to prepare for increased demands. These publications answer so fully and in such detail many questions pertaining to climate that were it not for them a much larger force of clerks would be required at the central office to supply requests for climatic data. The annual summaries are in especial demand. All weekly climate and crop bulletins are issued on Tuesdays, and the monthlies as soon as practicable after the close of each month. Most of the latter are ready from the 15th to the 20th, and practically all are issued by the end of the month succeeding that to which the report pertains. By a complete interchange of the monthly reports each section receives all the reports issued. These are carefully filed and are available for reference at all times. In addition to the section centers, 20 of the

more important stations of the Bureau also receive these monthly reports, and it is frequently found a means of convenience to refer applicants for information that these reports contain to the nearest Weather Bureau station having a complete file.

#### SNOW AND ICE BULLETINS AND THEIR USES.

In the winter time there is issued from the central office a snow and ice bulletin showing graphically the area covered with snow and the extent of its depth; also the thickness of ice in rivers and harbors. This bulletin has a wide circulation, and the information it contains has an important bearing upon the winter-wheat crop, besides supplying data of much value to the ice trade and to the manufacturers of goods, the demand for which is largely governed by the prevalence of sleet or snow, rubber goods, horseshoes, etc., coming under this heading.

In the States of the semiarid region local snow bulletins are issued by each climate and crop section center from December to March. These bulletins show the amount of snow and the depths remaining at the close of each month, this information being of great importance as affording a reliable basis for calculating the water supply for irrigation during the succeeding season. In some States a small amount is expended in obtaining snow measurements at high altitudes of difficult access where it is impossible to secure voluntary service.

#### VOLUNTARY STATIONS.

While more than 200 voluntary stations were established during the year, the total number, 3,355, is not quite so large as at the close of the previous year. This is due to the closing of many stations using nonstandard instruments in localities where the need for stations was not sufficiently urgent to justify their equipment with standard instruments. As in the past few years, efforts have been mainly directed toward standardizing and improving the outfits of voluntary stations rather than increasing their number. The plan of inspecting voluntary stations inaugurated in the previous year has been followed vigorously, 481 stations having been inspected by section directors during the year. The importance of these inspections can not be too strongly emphasized. Nothing can contribute more to the successful work of a voluntary station than a personal interview between the observer and the section director. These inspections, therefore, have unquestionably contributed much to the elimination of defects that are liable to exist, however careful the effort may be to guard against them. While many voluntary observers thoroughly understand their duties and perform them in a most satisfactory manner, it is found that there are few stations at which there is no opportunity for needed suggestions or instructions. As the inspections made in the previous year were largely confined to stations that could be reached without cost to the Bureau for transportation, the average expense, per station inspected, during the year ended June 30, 1903, was somewhat greater than in the previous year.

#### CORN, WHEAT, COTTON, SUGAR, RICE, AND FRUIT SERVICES.

The number of these stations and the manner of reporting and publishing data therefrom continue unchanged. The value of this



service is becoming more widely known each year, and numerous requests for the establishment of more stations are received from commercial organizations. Twenty-five additional stations can be advantageously placed in portions of the cotton belt not now well represented, and a like number of stations of the corn and wheat region service is also needed in the corn and wheat belt. Owing to the exceptionally mild weather conditions prevailing in the cotton belt during the autumn of 1902 the cotton interests felt the need of the reports from the cotton-region stations after the suspension of the service on October 31. Effort was made to meet this demand by a voluntary service, which was continued during November. Much difficulty was experienced during the spring of 1903 in securing the receipt at the district centers of the daily reports from substations in time to be included in the district averages telegraphed to other section centers, and efforts have been made to secure more satisfactory service. As a rule, however, many of the delayed reports are received in time to appear in the local bulletins although too late to be embodied in the district averages. The editions of the bulletins are larger than in previous years on account of the increasing demands. That the information contained in these bulletins may be given to the various interests in an impartial manner, they are issued simultaneously at 11 a. m., seventy-fifth-meridian time. A copy of each bulletin issued from corn, wheat, cotton, sugar, and rice centers is received at the central office, where they are carefully examined for errors or defects. The total number of corn and wheat bulletins issued daily during the season at 12 stations is 769, and the total number of cotton-region bulletins issued at 28 stations is 865.

The fruit and wheat service in California continues to supply the needs of the fruit and wheat interests of that State very satisfactorily. No bulletins other than those supplied to the press are issued, but through the circulation in the Pacific papers a wide dissemination of the data collected is secured.

#### DISTRIBUTION OF FORECASTS AND SPECIAL WARNINGS.

Inadequate appropriations have prevented any extensions in this important work, and of necessity we have been compelled to confine our efforts to maintaining the service already in operation, with its various ramifications, and adopting suggested improvements which might be effected without additional expense to this Bureau.

While a reduction of 131 is shown in the number of stations receiving forecasts by telegraph or telephone at Government expense, this indicates no impairment in the efficiency of this class, for the points discontinued were unimportant as centers, or the substations were transferred to some equally well located center of distribution, and very few, if any, interests were deprived of the forecasts by this action.

No change has been made in the system of emergency warnings and the number of authorized stations remains the same as at the date of my last report. This statement also applies to the railway train service, there having been no change, of record, in this work during the past year.

The dissemination of forecasts over the telegraph lines of a number of the great trunk railroads has been continued, while the service has been discontinued by a few of the smaller roads, owing to increased



business over their wires, entailing a loss of about 200 points receiving the daily reports for posting in the railroad stations.

A marked increase (nearly 20,000) is shown in the number of places receiving forecasts by telephone without expense to the United States, and with the rapid extension of "farmers' telephone lines" (so called) opportunity is afforded for placing weather information directly in the homes of the more progressive agriculturists as well as in the telephone exchanges of rural centers of population, where it is posted for the benefit of the general public. The managers of these local telephone lines seem to be very much interested in this matter, and with very few exceptions have given their hearty support in making the distribution as successful as possible. It is not difficult to secure the cooperation of these officials, as a statement of the fact that forecasts can be had gratis adds to the inducements which they can offer to prospective subscribers. The great advantages of this plan of dissemination are apparent when we consider the very early hour at which the production reaches the subscriber and the slight amount of labor involved in furnishing him with the information.

The list of places supplied with daily forecasts through the regular mails has been increased by nearly 4,000, showing a healthy growth in this class, although no efforts have been made, owing to lack of funds, toward an extension. The post-offices receiving card forecasts by the logotype system are being charted on post-route maps in this division, and any irregularities that may appear are corrected, and any offices not receiving the forecasts, which can be reached from any distributing center in time to make the information of benefit, are added to the lists of the proper center. This branch of the work is confined, as a rule, to a. m. forecasts, which can be posted in the various offices before 6 o'clock p. m. of the day of issue. Some of the distributors display considerable ingenuity in their devices for saving time and labor in this work, and I wish to invite particular attention to the work done at Marshalltown, Iowa, where the cards and slips are printed in three colors, with the regular logotypes, on a rapid printing press invented by the distributor.

The decrease of 7,500 in the number of families receiving forecast slips through the rural free-delivery service is due mainly to a change in the hours of departure of carriers from terminal points which precluded their receiving the forecast telegrams in time for distribution, as it has been the policy of the Bureau to allow only the distribution of the a. m. forecasts, except in a limited number of cases where the circumstances justified a departure from this rule. Where carriers leave before 8 a. m. and the distributing station has no "all night" telegraph office, there is no possibility of the messages being delivered in time to allow the forecasts to be duplicated and given to the carriers before their departure. There appears but one remedy for this, and that is to utilize the p. m. forecasts alone for rural free-delivery distribution, and have carriers supplied by mail train with their slips from a regular Weather Bureau station equipped with a rapid printing press like those now in use at the Boston and Columbus stations.

The agricultural sections are now our principal field of operations, and the rural free-delivery is the means for reaching them; and, as stated in my previous report, it seems particularly unfortunate that, at this time, when the Bureau has opened up to it such a great opportunity for increasing its usefulness to the farming classes, we are debarred from taking the action indicated owing to insufficient appro-

priations. Numerous requests for forecasts are being received from persons living on rural free-delivery routes which we are compelled to refuse for reasons above stated.

The following table shows the geographic extent of this work, as well as the changes, as compared with the distribution of the previous year:

*Distribution of daily forecasts and special and emergency warnings.*

States.	At Government expense.			Without expense to Government by—					
	Forecasts, daily.	Special warning.	Emergency warning.	Telephone.		Railway telegraph, daily.	Railway train service, daily.	Mail, daily.	Rural free-delivery service, daily.
				Forecasts, daily.	Special warning.				
Alabama .....	25	5	152	68	94	83	12	960	857
Arizona .....	3	1	0	2	0	0	0	0	0
Arkansas .....	26	7	118	4,025	2	12	0	523	250
California .....	120	15	0	32	177	356	0	2,405	3,228
Colorado .....	20	18	81	48	200	2	7	1,016	1,240
Connecticut .....	14	4	52	0	0	15	151	1,109	100
Delaware .....	9	0	25	0	0	32	0	68	720
District of Columbia .....	0	0	0	11	11	0	0	1,264	0
Florida .....	27	125	95	34	132	91	0	1,193	0
Georgia .....	38	42	268	26	76	222	41	1,520	970
Idaho .....	12	1	0	7	22	0	17	403	101
Illinois .....	111	28	524	1,867	264	131	459	2,992	7,532
Indiana .....	100	10	242	3,530	131	68	287	2,000	5,877
Indian Territory .....	10	0	5	20	20	0	0	152	0
Iowa .....	143	30	480	7,554	222	13	0	1,889	9,037
Kansas .....	72	6	217	315	169	30	15	964	3,841
Kentucky .....	34	37	102	131	20	21	0	3,122	75
Louisiana .....	25	45	71	9	22	8	0	940	25
Maine .....	24	5	46	6	20	0	77	1,635	1,120
Maryland .....	28	7	89	17	34	84	0	1,855	1,384
Massachusetts .....	25	21	71	12	50	1	331	2,923	10,125
Michigan .....	113	23	443	85	256	269	457	4,893	5,376
Minnesota .....	53	16	217	500	544	13	0	2,023	2,062
Mississippi .....	27	8	75	39	25	10	0	737	0
Missouri .....	86	11	280	3,640	182	36	0	4,232	6,310
Montana .....	16	3	24	6	16	0	0	504	0
Nebraska .....	63	11	241	406	49	0	0	936	1,415
Nevada .....	3	0	0	0	0	0	0	178	0
New Hampshire .....	17	1	39	0	0	0	31	1,281	1,205
New Jersey .....	29	22	127	6	22	189	0	1,406	255
New Mexico .....	4	2	0	0	0	9	0	15	0
New York .....	118	60	407	458	961	305	168	6,985	10,454
North Carolina .....	47	21	214	25	46	1	16	1,256	453
North Dakota .....	13	12	104	0	0	0	0	29	215
Ohio .....	125	93	407	2,249	1,787	37	17	8,289	14,292
Oklahoma .....	8	2	15	1	30	9	0	176	0
Oregon .....	18	2	0	0	32	0	104	646	695
Pennsylvania .....	52	22	345	799	358	727	0	4,290	455
Rhode Island .....	5	0	13	44	7	0	28	102	0
South Carolina .....	36	6	125	30	277	30	23	1,097	456
South Dakota .....	34	26	111	86	284	0	0	706	195
Tennessee .....	43	10	305	108	165	23	2	1,606	1,715
Texas .....	56	67	278	165	453	163	0	1,666	2,293
Utah .....	12	57	0	0	0	0	0	202	290
Vermont .....	11	1	50	0	0	8	13	542	100
Virginia .....	41	9	109	157	53	60	96	1,709	228
Washington .....	20	3	0	2	52	0	29	706	548
West Virginia .....	22	11	74	522	245	18	26	1,094	232
Wisconsin .....	71	16	447	1,503	92	0	16	1,820	1,852
Wyoming .....	6	4	8	6	0	11	0	105	40
July 1, 1903 .....	2,015	926	7,096	28,251	7,602	3,087	2,423	78,164	97,648
July 1, 1902 .....	2,146	921	7,096	8,297	12,872	3,280	2,423	74,327	105,161
Changes .....	-31	+5	0	+19,954	-5,270	-193	0	+3,837	-7,513

The chief of the climate and crop division has charge of some of the most important work of the Bureau, viz, the climate and crop service and the distribution of forecasts and special warnings. Fifty-two of the higher station officials are partially engaged in work under his general supervision. Paid observers at 293 stations of the corn and wheat, cotton, sugar and rice, and fruit services are under his exclusive

direction, and nearly 30,000 persons serving gratuitously in the capacity of crop correspondents, forecast distributors, and voluntary observers contribute to the work under his charge. Approximately, one-third of the Bureau's appropriation for telegraphic purposes is expended annually in the collecting and disseminating work under his division. He writes the National Climate and Crop Bulletin, a work requiring skill in the handling of meteorological statistics and in the construction of temperature and precipitation charts, as well as ability to understand and intelligently discuss the effects of weather on growing crops. The State sections of the climate and crop service are under his supervision. There are 42 sections, each publishing monthly climatic reports the year around, and weekly climate and crop bulletins during the period of planting, cultivating, and harvesting of the more important staples.

I take this occasion to express my acknowledgment of the very valuable and efficient service of Mr. James Berry, chief of this division. His work in the climate and crop service demands a high order of intelligence and the utmost integrity, qualities which he possesses in an eminent degree, and which, when taken in conjunction with the importance of the work and his long experience of twenty-five years in the service of the Bureau, give him the strongest title to promotion. He now receives \$2,000, and I earnestly recommend his promotion to \$2,750. I make this recommendation in the earnest desire to deal justly with a man who has been a worthy assistant and most valuable public officer.

#### LIBRARY.

The work of the library has gone on in general as outlined in my last report. During the year there have been added 987 volumes, bringing the catalogued strength of the library up to 24,138 books and 4,430 pamphlets, making a total of 28,568 titles. These titles are represented by a complete author card index, and partly, about two-fifths, by a subject card index. It was expected that this subject index would have been completed during the year, but unavoidable contingencies prevented. A bibliography of current meteorological literature is now maintained and a selected part of it appears regularly in the Monthly Weather Review.

The steady flow of publications into the library from year to year has filled all available shelf room. Need of more room is urgent. The question has often been raised as to the limitation of the book accessions. As far as appears practicable restriction has been enforced. No works not clearly connected with the interests the Bureau serves are purchased. By far the greater part of the accessions are the meteorological publications of other national weather services received in exchange for our own publications, and they are properly the objects for the custody and care of which we are most interested in providing.

#### EXAMINATIONS.

During the year 69 employees asked to be examined for eligibility for promotion, in accordance with a system of examinations adopted and in force for this purpose since 1899. Of these, 44 passed the examinations prescribed for eligibility for promotion to salary grade \$1,000 per annum, 6 failed; 13 passed the examinations prescribed for promotion to salary grade \$1,200 per annum, 2 failed; 8 passed the



examination for promotion to salary grade \$1,400 per annum, 1 failed. One employee passed the examinations for promotion to both \$1,000 and \$1,200 per annum, and 1 passed the examination for all three grades. The subjects examined upon were: For promotion to salary \$1,000 per annum, grammar, arithmetic, elementary meteorology; for promotion to salary \$1,200 per annum, algebra, trigonometry, physics; and for promotion to salary \$1,400 per annum, astronomy, plant physiology, and advanced meteorology. The duty of preparing and marking the questions has been performed by the librarian in addition to the other duties devolving upon him.

These examinations serve a double purpose. With respect to the first, almost all of the employees entering the weather service are young men. Many are from colleges, others have had less educational advantages, but have managed to pass the required entrance examinations. Experience has shown that even in the case of high school and college men there is often a lack of thorough grounding in the elementary subjects of English, arithmetic, and algebra. Because of such experience, it has been found well to require that these elementary subjects be reviewed, and for this reason they have been made part of the promotion examinations. The other purpose is that of showing that advancement is dependent upon the possession of a comprehensive knowledge of meteorology and cognate sciences. Experience again shows that the most useful officials of the service are those who keep themselves best informed, both as to the routine work of the Bureau and its relations to other interests.

#### INSTRUMENT DIVISION.

The duties of the instrument division may be embraced under the following heads: "Instruments," "Storm-warning towers," "Experimental work," and "Exposition work."

A station is rated as completely equipped when instruments are installed by which the meteorological elements of wind velocity, wind direction, temperature, pressure, rainfall, and duration of sunshine are recorded.

During the past year new stations were fully equipped at Asheville, N. C.; Syracuse, N. Y.; Wytheville, Va.; Duluth, Minn. (substation); Concord, N. H.; Southeast Farallone Island, Cal., and Sand Key, Fla. The equipment of the stations at Alpena, Mich.; Amarillo, Tex.; Block Island, R. I.; Lynchburg, Va.; Roseburg, Oreg.; Wichita, Kans., and Williston, N. Dak., were brought up to a standard of completeness. There are now 138 stations completely equipped. Those remaining, numbering about 60, are either special agencies, display stations at which anemometer records only are desired, or are of such minor importance that the present equipment is sufficient. A very considerable number of automatic instruments are, nevertheless, maintained at the incompletely equipped stations, some of which lack only a single instrument.

The following shows the total number of the principal instruments in active service:

Triple registers.....	161
Barographs (includes 35 in lake marine service).....	220
Thermographs.....	162
Telethermographs.....	8
Tipping bucket gauges.....	141
Electric sunshine recorders.....	145
Photographic sunshine recorders.....	30



Nearly all the stations that are completely equipped have, in addition to the instruments mentioned above, certain duplicates, constituting an "Exhibit equipment."

The automatic instruments are operated almost wholly by electricity, and heretofore the current has been obtained from an improved form of primary battery consisting of zinc and oxide of copper elements in a solution of caustic soda. While they have proved vastly superior to the old "bluestone" batteries, yet their maintenance involved expense and trouble for recharging. Steps have been taken to introduce small storage batteries, which have now been brought to a high state of efficiency. Unfortunately, these storage cells can only be used at stations having a direct-current system of electric lighting. The original installation costs but a trifle more than one set of the ordinary primary batteries, and no further expense is necessary, since the batteries are charged from the lighting current. The use of the storage cells not only provides a more satisfactory source of electric energy, but also effects a saving of from \$10 to \$15 a year for each station. About 50 stations are now supplied with suitable current, and action is being taken to equip these with storage cells in the near future.

#### NEW SEISMOGRAPH.

It has long been the policy to maintain a special equipment of instruments at the central office in Washington. An instrument of unique interest is the seismograph. For a number of years practically the only instrument of the kind maintained in operation in North America was the one in the Weather Bureau. Several others existed, but because of the infrequent occurrence of earthquakes they were not kept in condition to make records. During the past year a new seismograph of modern design and of greatly improved type was procured and installed. A distinct earthquake was recorded March 15, 1903, and another of much longer duration on June 2, 1903. A detailed account of these shocks and a description of the seismograph will be published in the Monthly Weather Review. Any considerable earthquake that occurs on any point of the globe is now pretty certain to be more or less fully recorded at Washington. Where seismographs of the degree of sensitiveness possessed by the one now in use have been maintained for periods of a year or more, a peculiar type of record has been traced from time to time which, as yet, is not fully understood. Omori, of Japan, classifies the phenomena as "pulsatory oscillations," and the opinion prevails generally that the origin of these waves is not seismic but meteorologic, and that it is probably connected with unusual conditions of atmospheric pressure. The records made in such cases show that the crust of the earth is in a state of continuous oscillation of appreciable amplitude. This motion goes on hour after hour, sometimes for a day or more at a time, but the data accumulated thus far are too meager to afford a satisfactory explanation of the phenomena. Colonel Bingham, in reporting upon the behavior of the long pendulum installed in the Washington Monument, states that "on many days of perfect calm the plumb line vibrates excessively, whereas on days when a high wind is blowing the plumb line will be at rest." There can be no doubt that the days on which the pendulum vibrates are days of pulsatory oscillations of the earth's crust at Washington. In the future such vibrations will be recorded on the seismograph.

## STORM-WARNING TOWERS AND LANTERNS.

The duties of the instrument division in connection with the storm-warning towers are confined to the details of their purchase, installation, and maintenance. The selection of the stations and the management of the funds for the work are supervised by the forecast division. During the two preceding years the available funds have not been adequate for the entire work. Only a few stations were equipped last year, most of the funds being expended for high-power electric and oil-burning lanterns, which were necessary to complete the equipment of a large number of stations at which towers had been erected. The improved equipment of storm-warning towers and lights is now completed at about 130 stations, and action is being taken to equip 25 additional stations during the fiscal year 1903-1904. When Congress was requested to appropriate for storm-warning towers the estimate of cost was based on about 125 stations. By the close of the year 1903 nearly 25 per cent more stations will have been fully equipped than were originally contemplated.

## AERIAL RESEARCH.

A careful study of the mechanical, instrumental, and engineering problems involved in aerial research was entered upon by Professors Abbe and Marvin, and it was pushed as rapidly as their other duties would permit. The problem has been carefully studied in order that no blunder might be made that would develop after the work of the taking of observations had begun. A series of experiments was begun with small rubber balloons, for the purpose of testing the elasticity and other qualities of thin rubber. Investigations were made into the sluggishness of such forms of thermographs as might be used in ascensions. This is a work that had been neglected. A thermograph rising or falling rapidly through the air is exposed to a constantly changing temperature, and, owing to its sluggishness, the indicated temperature is more or less seriously in error. If the coefficient of sluggishness under the different conditions of usage can be ascertained the proper corrections can be applied to the records. The instruments can then be caused to ascend or descend rapidly through the air (1,000 feet per minute or more) and correct records obtained. This means quick and high ascensions and a more certain recovery of the apparatus. The following summary indicates what has been done:

Toluene thermometers, according to the hydrogen scale of International Bureau adjusted to  $-0.70^{\circ}\text{C}$ ., procured for comparison of instruments.

Special vacuum low temperature chamber designed and constructed.

Specimen rubber balloons of European manufacture procured.

Numerous tests made of surface tension, pressure, density, etc., of small rubber balloons.

Special type of platinum resistance thermometers and direct reading indicator, for use in the vacuum low temperature apparatus, devised and constructed.

Several types of European baro-thermographs procured for test and inspection.

The construction of netting, parachutes, etc., and disposition thereof, carefully studied.

Investigations made in the electrolytic generation of hydrogen, the best type of engine for the work, and the problem of easily and quickly testing the composition of the gases.

The theory of the sluggishness of the thermographs was formulated and apparatus and methods of measuring sluggishness developed and applied.

The study of the diffusion of hydrogen through thin sheets of rubber was begun.

The policy recently inaugurated of building up a great center of meteorological research at Mount Weather is undoubtedly one of the most important steps that have been taken at any time in the history of the Bureau to place the scientific side of the service upon a firm basis, and it is certain to bring valuable results. The importance of a careful study of all details in any way connected with instruments or apparatus is recognized, as the future suitability of installations depends upon their broad adaptability to many and diverse uses.

#### EXPOSITIONS.

The instrument division has been charged with the immediate care of the exhibits made at Buffalo, Charleston, Providence, and the one to be made at St. Louis. The instrumental section of the Buffalo exhibit was transferred to Charleston and later to Providence.

#### DIVISION OF METEOROLOGICAL RECORDS.

The routine work of examining meteorological forms from regular and cooperating stations, and entering the data in the record books; preparing and tabulating data for the Monthly Weather Review, for the Annual Summary of the Weather Review, and for the Annual Report of the Chief of Bureau; preparing error letters to employees of the Bureau and cooperating observers; receiving and checking the receipt of regular and voluntary forms; preparing data for certification under seal of the Department for use as evidence in cases at law before the various courts of the country, and for many other purposes, has continued throughout the year. There are 3,173 reports from voluntary observers examined each month.

A set of division tables, adapted from tables submitted by Mr. H. W. Smith, Mr. Arthur Thompson, and Mr. Hermann Volker, were published. This was a task requiring great accuracy in verification of figures and much time in preparation. The tables will be a great aid to speed and correctness in preparing forms at stations, and are satisfactory.

There is now being prepared, under the supervision of this division, a new series of climatic charts.

Temperature normals—mean daily values—for all stations for the twenty-five-year period, 1879–1903, inclusive, are now being prepared. The initial portion of this work necessitated the entering of each day's mean at all stations for the years 1896–1903, inclusive. At stations having less than a twenty-five-year record, an arbitrary correction will be used, which will be arrived at by taking the means of identical years at contiguous stations, finding the difference from the twenty-five-year mean, then applying the mean correction of all the stations under consideration to the mean of the short period, thus making it comparable with stations having a full twenty-five-year record. The daily values of the short-record period will be fixed by taking the curve for some adjacent station whose temperature conditions are believed to be about the same as at the station under discussion.

In working up these daily values much time has been saved and great accuracy obtained by the use of an adding machine.

New precipitation normals, also, are being prepared for all stations, and determined from the beginning of record to the year 1903, inclusive.



An unusual amount of data was prepared for the committee on the Charles River Dam, of Boston; the waterworks department of New York City; for several Bureaus and Divisions of the Department, and the U. S. Geological Survey; for business people, invalids, health and pleasure seekers, etc.; and many calls for data from civil and hydraulic engineers, etc., have been filled by furnishing publications of the central office, climate and crop centers, and individual stations.

An increase of 2 clerks at \$1,000, 2 at \$840, and 1 at \$720 per annum is recommended to do the additional work imposed on this division by the increasing demands for data and to verify the records received from the new stations established during the past several years.

#### MONTHLY WEATHER REVIEWS AND WORK OF THE EDITOR.

Professor Abbe has devoted his time to editing the Monthly Weather Review and making the preliminary arrangements for the inauguration of a systematic research into the meteorological conditions of the upper air by means of kites and special small hydrogen gas balloons. The aerial investigations, however, have recently been assigned to Professor Bigelow.

The Monthly Weather Review has continued to be published as promptly as possible, the number for April, 1903, appearing on June 20, 1903, being five days after the prescribed date. New type, improved presswork, and a better quality of paper have added much to the attractiveness of the publication. Many articles published in the Review have been in such demand by students and scientists that separate prints have been made of many of them.

A memoir by Dr. J. W. Sandström, of Stockholm, on the construction of isobaric charts at high levels in the atmosphere and their significance in the dynamics of the atmosphere has been translated and prepared for publication as an independent bulletin, as it is rather too large to go into the Monthly Weather Review.

The following articles that seem worthy of mention appeared in the Review during the past year:

W. A. Bentley: "Studies among the snow crystals during the winter of 1901-2." This article was published in the last number of Vol. XXX, or the summary for 1902; it contained an analysis of the types and frequency of types of snow crystals, notes on their internal structure, and on the relation of the types to the location and distance of the storm center. With this was published a collection of 255 photomicrographs of snow crystals engraved by the half-tone process and printed with great care, so as to bring out as far as practicable many of the details of internal structure that were to be seen on the original photographs. This beautiful memoir has received much praise, and many special requests for it have been received.

R. A. Harris: "Note on the oscillation period of Lake Erie" (June, 1902), and "The semidiurnal tides in the northern part of the Indian Ocean" (April, 1903). These papers explain certain oceanic tidal phenomena by the oscillation of the whole mass of water as a unit in lakes or certain parts of the ocean. Similar oscillations occur in the atmosphere when it is resting quietly, as may easily be observed by means of layers of smoke or fog.

Prof. F. H. Bigelow: "A contribution to cosmical meteorology" (July, 1902); "Studies on the meteorological effects of the solar and terrestrial physical processes" (December, 1902); "Synchronous changes in the solar and terrestrial atmospheres" (January, 1903); "The structure of cyclones and anticyclones on the 3,500-foot and 10,000-foot planes for the United States" (January, 1903); and "The mechanism of counter currents of different temperatures in cyclones and anticyclones" (February, 1903). These papers represent an immense amount of study and labor, and have undoubtedly given precision to our ideas as to the conditions prevailing in the general atmosphere and in the midst of the highs and lows. Extra charts have been published in the Review, so as to more fully elucidate Professor Bigelow's conclu-

sions and accustom the forecasters of the Weather Bureau to the careful study of the isobars and isotherms at high levels.

A. L. Rotch: "The International Aëronautical Congress at Berlin" (July, 1902). This is a full report on the congress of May, 1902, made by Mr. Rotch, as representing the U. S. Weather Bureau. This congress afforded our first opportunity to learn of the success of the Berlin meteorological office in using small rubber balloons for carrying meteorographs to the greatest possible heights. It also showed that European meteorologists were unanimous and enthusiastic in their cooperation in the work of the general investigation of the conditions prevailing in the upper atmosphere. Hypotheses on this subject can no longer be acceptable, in view of the actual knowledge gained and the unexpected facts revealed by the work done with kites and balloons.

L. Teisserenc de Bort: "The Franco-Scandinavian station for aerial soundings" (April, 1903). Our distinguished colleague here gives us the first detailed account of the station established at Viborg, Denmark, by the cooperation of France, Denmark, Norway, and Sweden. Balloon and kite ascensions were made as often as possible during one year, and the results were promptly printed, although it is not known that they have as yet been distributed or published.

S. R. Cook: "The permanency of planetary atmospheres according to the kinetic theory of gases" (August, 1902). This is virtually an inquiry into the origin and history of the evolution of the earth's atmosphere. Mr. Cook's investigations confirm some of the calculations previously made by others, and he concludes that, in general, helium forms a constituent, though a very small part, of the earth's atmosphere; helium will be retained by the earth's attraction at much higher temperatures than now prevail. All the planets can retain atmospheres similar to the earth's, and the superior planets can retain gases much lighter than hydrogen. The vapor of water will remain on the planet Mars at ordinary temperatures. If the moon had a mean temperature as low as that of freezing water, it would lose any nitrogen and oxygen that it might have in its atmosphere.

L. N. Jesunofsky: "Some peculiarities in frost formations" (October, 1902). The author gives details as to numerous irregularities in the formation of frost in the neighborhood of Charleston, S. C. These are evidently due to local peculiarities in the soil and plant covering, as also to the presence of small regions of moist air following slight haze or fog, but in many respects they have not yet been satisfactorily explained.

B. C. Webber: "November gales from the Great Lakes to the Maritime Provinces" (November, 1902) and "March winds" (March, 1903). These two articles by the acting director of the meteorological service of Canada called attention to interesting peculiarities in our winds. They have also given occasion to the following paper by Mr. Stockman.

William B. Stockman: "March and winter winds" (May, 1903). In this article the author shows that the windstorms of the winter months occur with temperatures above normal, and that storms are more frequent in March than in the winter months, except in the east Gulf and Atlantic coast States, the lower lake region, and the upper Ohio Valley.

T. H. Davis: "Annual wind resultants" (November, 1902) and "Typical October winds on our Atlantic coast" (April, 1903). Mr. Davis has spent his spare time for many years in computing the resultants of the wind direction, both for hourly records and for tridaily records at our observing stations. He shows that at many stations the oscillations of the wind resultants go through a system of systematic changes from year to year, and that at neighboring stations these changes are analogous, but at distant stations they may be in opposite directions at the same time. For stations such as Key West and Bermuda, where the strictly local influences are uniform, the changes in the wind appear to depend upon changes in the so-called general circulation of the atmosphere. Mr. Davis is not able to find any special connection with changes in the sun spots or the moon or other cosmical phenomena. He maintains that the dignity of meteorology as a science can only be maintained by adhering closely to observed natural phenomena and avoiding popular discussions of supposititious events.

A. H. Thiessen: "An explanation of wireless telegraphy" (December, 1902). This article is very popularly written and abundantly illustrated; it has been widely praised as a very clear, simple, popular, and scientifically correct exposition of a subject in which all are interested and which may eventually become of great importance in the daily work of the Weather Bureau.

S. J. Allen: "Radio-activity of freshly fallen snow" (December, 1902). The author has extended the work of C. T. R. Wilson, on freshly fallen rain, and has shown that snow as well as rain brings down a radio-active substance from the upper atmosphere.

It follows, from the researches of Elster and Geitel and J. J. Thomson, that this radio-active substance must consist of molecules charged with negative electricity, or the so-called negative ions. As moisture condenses most easily on the negative ions, it should follow that in the upper atmosphere there is left behind an excess of positive ions, or positive electricity, thereby explaining the existence of the so-called atmospheric electricity.

H. Ebert: "Atmospheric electricity considered from the standpoint of the theory of electrons" (May, 1903). This is the best popular exposition that has as yet been published on the present state of our knowledge of atmospheric electricity. It enables us to understand the many difficulties that have hitherto stood in the way of utilizing observations of atmospheric electricity for storms and other predictions. It also furnishes ground for hope that the new methods of observation perfected by Elster and Geitel and Ebert will make it possible to obtain from many stations electrical data that shall be comparable among themselves and be useful in the work of forecasting. As Ebert says, "We have acquired a point of view that promises to contribute very much to the solution of problems that are centuries old."

H. H. Kimball: "Abnormal variations in insolation" (May, 1903). As one of the results of Mr. Kimball's work at Asheville, N. C., he was able to point out that during January, February, and March, 1903, there was received at his locality decidedly less solar heat than was to be expected. A similar observation was made by Monsieur Dufour at Lausanne, Switzerland, and some irregularities of the same kind at Montpellier, France, in the years 1884-1886 were pointed out by Mr. C. G. Abbot in the *Monthly Weather Review* for April, 1902. It is at present impossible to state with certainty whether these sudden diminutions in insolation are due to changes on the sun's surface or to increased absorption in special parts of the earth's atmosphere. The latter idea is the most plausible, and it remains to be ascertained whether the absorption was produced by dust and moisture in the atmosphere, and if so, where these came from.

W. N. Shaw: "Meteorological observations obtained by the use of kites" (May, 1903). The importance of the atmospheric data attainable by the use of kites is appreciated more highly every year. Considerable work of this kind was accomplished under the auspices of the Royal Meteorological Society during July and August, 1902, by forty kite ascensions from the deck of a tug steaming off the west coast of Scotland. Mr. Shaw furnishes an abstract of the results, showing especially the temperature gradient for each 500 meters of vertical height above the surface of the ocean; the average gradient is almost identical with the so-called adiabatic rate for saturated air and also with the temperature gradient used in reducing temperatures to sea level, viz,  $1^{\circ}$  F. per 300 feet, as originally adopted by Espy and still used in England. The author adopts the explanation that for these lower altitudes the air flowing from the ocean eastward and forced to rise above the Scottish mountains must be mechanically raised, and becomes, therefore, practically subject to the adiabatic gradient, which is not reached in the free atmosphere, except when the air is rapidly rising or falling. The most remarkable result of the highest balloon explorations has been to show that at great elevations the air is also frequently found to show the adiabatic gradient of temperature, and must, therefore, be recognized as probably in a state of rapid rise or fall.

Prof. J. R. Plumandon: "Cannon and hail" (summary, 1902). As the reports of the various international conferences on the efficiency of cannonading against hailstorms have been frequently misquoted, Professor Plumandon, as secretary of the congress, has prepared this summary of results, and concludes with this admonition to American readers: "Before undertaking the protection of your crops by cannonading wait until that method of protection has furnished good results in the countries where it is now being tried."

Louis Besson: "The vertical component of the movement of clouds" (January, 1903). The general use of the nephoscope in determining the heights and movements of clouds is so important that this contribution to the literature of the subject is very welcome. The so-called vanishing-point nephoscope, described by Professor Abbe in his "Treatise on meteorological apparatus and methods," can be used with especial convenience to carry out the investigation described by Mr. Besson; it did, indeed, as there stated, as early as 1872, lead to the visible demonstration of the fact that in the neighborhood of the center of low pressure the clouds on opposite sides of the horizon have slightly different movements, both horizontally and vertically, so that the presence and location of the central low is easily determined.

J. R. Benton: "Elasticity at low temperatures" (January, 1903). The results of this memoir bear directly upon the construction of meteorographs for use in the low temperatures that are continually occurring in meteorology. The author shows that steel springs may be relied upon at temperatures where other materials fail, and



that the law of change of elasticity is quite regular, though not as great as the change that takes place in india rubber or in fusible metals.

Prof. A. G. McAdie: "High wind records on the Pacific coast" (February, 1903) and "High winds at Point Reyes light" (May, 1903). In these articles, with the accompanying note by Professor Marvin, we have apparently reliable records of northwest gales whose extreme velocity measured 120 miles per hour during gusts of a minute's duration and whose movement for a whole hour was 78 miles. For eight consecutive days the velocity varied between 46 and 70 miles per hour. The fact that such a record can be maintained without interruption is a high tribute to the excellence of the anemometer, the recording apparatus, and the faithful attention given to these by the observer, Mr. W. W. Thomas.

Charles A. Mixer: "The water equivalent of snow on the ground" and "River floods and melting snow" (April, 1903). These papers give exact data in reference to an important subject on which we have hitherto had indefinite ideas. The snow lying on the ground at the end of winter is in many locations the sum total of the winter snowfall, only slightly diminished by an occasional thaw and compacted into a dense mass. The sudden melting of this snow in the warm weather and sunshine of spring, and especially by the influence of the warm spring rains, forms the most important constituent of dangerous spring floods in our northern rivers. Mr. Mixer very properly urges that every rainfall and river station should keep a record of the water equivalent of the snow lying on the ground just as it does of each fresh snowfall. In some cases quoted by him 38 inches of snow on the ground gave 10.5, 20 inches gave 9.8, and 90 inches gave 6.3 inches of water.

E. Buckingham: "On the radiation formulas and on the principles of thermometry" (April, 1903). This is an exposition of the proper method of applying various empirical formulae for the observed quantity of radiation from any surface to the determination of the actual temperature of the radiating surface. Mr. Buckingham's exposition is applicable, not only to the determination of the temperature of the surfaces from which radiant heat is received, but also to the investigation of the theory of the errors of Angström's pyrheliometer and of similar apparatus.

D. T. MacDougal: "The influence of light and darkness upon the growth and development of plants" (April, 1903). This is a summary by Dr. R. H. Pond of the results attained by Professor MacDougal in many years of most careful experimentation. The subject is one that is fundamental in the study of the relation between climatology and plant life, and it prepares the way for the proper study of many problems in the economy of plant life and for the intelligent application to the needs of the farmer of the observed Weather Bureau data relative to sunshine, cloudiness, temperature, and rainfall.

Henry L. Abbott: "Climatology of the Isthmus of Panama" (March and April, 1903). In these articles General Abbott, by combining all accessible information, has been able to give a rational explanation of the observed oscillations of rainfall, temperature, and wind in this tropical region. He has also been able to deduce reliable values of the monthly and annual mean barometric pressures reduced to sea level.

H. W. Richardson: "Composite and other arrangements of weather types" (February, 1903). In this paper the author explains the method he has used for several years in collecting together weather maps of the same type and assorting them for study. He classifies them as composite and associate types. He notes that there is an apparent tendency of the centers of high and low areas to move (in twenty-four hours) from the center of an area of positive or negative twenty-four-hour pressure change to the edge of the same area.

W. M. Fulton: "The automatic river gauge at Chattanooga, Tenn." (May, 1903). This apparatus, as invented by Mr. Fulton, consists of two parts, one at the river which measures the stage of water, and the other at the Weather Bureau station, which records the stage of water. The two parts are connected by a telegraph line. Analogous apparatus has been constructed from time to time by others for recording both river and other natural phenomena, but as a rule the difficulty of maintaining the line intact and the uncertainty of electrical apparatus in general has led to the abandonment of the method. In the present case Mr. Fulton has overcome several instrumental difficulties, and as the apparatus has worked satisfactorily for several months copies of it have been desired for other stations.

Weather Bureau men as instructors: Among the numerous "Notes by the editor," attention is especially called to those dealing with the work done by employees of the Bureau along educational lines. Rather elaborate courses of instruction are given at Columbian University, Washington, D. C.; the University of Cincinnati, Cincinnati, Ohio; the Medical College of Virginia, Richmond, Va.; Buchtel College, Akron, Ohio; Johns Hopkins University, Baltimore, Md.; the medical department of the

University of Missouri, Columbia, Mo.; the Kentucky State College, Lexington, Ky.; Norwich University, Northfield, Vt.; the Ohio State University, Columbus, Ohio; Yale University, New Haven, Conn.; Cornell University, Ithaca, N. Y.; Mercer University, Macon, Ga.; the University of Tennessee, Knoxville, Tenn.

In all these cases the course of instruction averages about two hours per week during at least four months, or one hour weekly for the whole college year. In general, the educational work is so arranged as not to interfere with official station duties and is done without additional compensation, except that in some cases a small honorarium is offered. Further details are given in the Monthly Weather Review for April, 1903.

#### ACCOUNTS DIVISION

In regard to Mr. Almerico Zappone, assistant chief of the Division of Accounts and Disbursements of the Department, who is assigned to charge of the accounts of the Weather Bureau, I desire to make a special recommendation. During a long experience in the Weather Bureau service (twenty-three years) this official has been distinguished by his exemplary conduct and a most faithful and intelligent performance of the exacting duties devolving upon him. In three Bureaus, whose appropriations are comparable with the appropriation made for this service, the salaries paid to the disbursing officials are greater than Mr. Zappone's by \$500, although with one exception the money handled by him at this office is in excess of that handled in the others. His work is also subject to the supervision of the Disbursing Officer of the Department, and I have every reason to believe that that officer will join me in the earnest recommendation I now make that Mr. Zappone's salary be advanced from \$2,000 to \$2,500 per annum.

#### BUILDINGS ERECTED, REPAIRED, AND IMPROVED.

During the past two fiscal years, through the appropriations by Congress, it has been possible to erect buildings for use as meteorological observatories for the Weather Bureau at the following-named places:

Atlantic City, N. J.:	
Cost of lot (Government reservation); cost of building.....	\$6,000.00
Hatteras, N. C.:	
Cost of lot, \$125; cost of building, \$4,875.....	5,000.00
Fort Canby (North Head), Wash.:	
Cost of lot (Government reservation); cost of building.....	3,992.63
Port Crescent, Wash.:	
Cost of lot (Government reservation); cost of building.....	1,000.00
Tatoosh Island, Wash.:	
Cost of lot (Government reservation); cost of building.....	4,950.00
Point Reyes, Cal.:	
Cost of lot (Government reservation); cost of building.....	2,989.90
Amarillo, Tex.:	
Cost of lot, \$1,255; cost of building, \$6,503.....	7,758.00
Modena, Utah:	
Cost of lot (Government reservation); cost of building.....	4,346.00
Key West, Fla.:	
Cost of lot, \$2,020; cost of building, \$7,994.75.....	10,014.75
Sand Key Island, Fla.:	
Cost of lot (Government reservation); cost of building.....	5,593.00
Southeast Farallone, Cal.:	
Cost of lot (Government reservation); cost of building.....	5,211.22
Mount Weather, Va.:	
Cost of lot, \$1,413.90; cost of building, \$15,663.13.....	17,077.03
Total.....	73,932.53

In addition, it has been possible to repair and improve the following buildings at the total cost set opposite each, viz:

Bismarck, N. Dak.....	\$7,064.14
Jupiter, Fla.....	3,358.00
Kittyhawk, N. C.....	125.00
Cape Henry, Va.....	5,104.25
Total.....	15,651.39

#### BUILDINGS IN COURSE OF ERECTION.

Buildings are now in course of erection at the following places:

Yellowstone Park, Wyo.:	
Cost of lot (Government reservation); cost of building.....	\$11,500
Duluth, Minn.:	
Cost of lot, \$2,100; cost of building, \$7,900.....	10,000
Devils Lake, N. Dak.:	
Cost of lot, \$2,300; cost of building, \$8,000.....	10,300
Havre, Mont.:	
Cost of lot, \$1,850; cost of building, \$5,700.....	7,550
Mount Weather, Va.:	
Cost of lot, \$650; cost of building, \$10,000.....	10,650
Block Island, R. I.:	
Cost of lot, \$1,100; cost of building, \$7,700.....	8,800
Narragansett Pier, R. I.:	
Cost of lot, \$4,100; cost of building, \$8,000.....	12,100
Total.....	70,900

#### AREA OF LAND OWNED BY THE WEATHER BUREAU.

The area of land purchased by the Weather Bureau during recent years, or transferred to that Bureau by the various branches of the Government, is as follows:

	Area.
Atlantic City, N. J.....square feet..	5,000
Cape Henry, Va.....acre..	$\frac{1}{2}$
Hatteras, N. C.....do..	$\frac{1}{2}$
Jupiter, Fla.....do..	$\frac{1}{2}$
Kittyhawk, N. C.....do..	$\frac{1}{4}$
North Head, Washington.....do..	$\frac{1}{2}$
Point Reyes light, California.....do..	$\frac{1}{2}$
Port Crescent, Wash.....do..	1
Sault Ste. Marie, Mich.....square feet..	2,000
Tatoosh Island, Washington.....acre..	$\frac{1}{2}$
Yuma, Ariz.....do..	1
Amarillo, Tex.....do..	$\frac{2}{3}$
Key West, Fla.....do..	$\frac{2}{3}$
Bismarck, N. Dak.....acres..	3
Sand Key, Fla.....square feet..	2,500
Southeast Farallone, California.....acre..	$\frac{1}{2}$
Mount Weather, Virginia.....acres..	77 $\frac{1}{4}$
Modena, Utah.....acre..	1
Yellowstone Park, Wyo.....do..	1
Duluth, Minn.....do..	$\frac{1}{2}$
Devils Lake, N. Dak.....do..	$\frac{2}{3}$
Havre, Mont.....do..	$\frac{1}{3}$
Block Island, R. I.....acres..	1 $\frac{1}{4}$
Narragansett Pier, R. I.....do..	1 $\frac{3}{4}$
Total area (about).....do..	94

The wisdom of the Weather Bureau in erecting and owning its own buildings becomes more apparent each day. It not only saves to the



Government the amount heretofore paid for rent of office quarters, which in many cases are unsuited to our needs, especially as regards the architecture of the roofs for the exposure of meteorological instruments, but places the Weather Bureau on a footing of equality with other branches of the Government service, such as the Light-House Board and Life-Saving Service. Aside from this, they provide living accommodations for our employees, who are so often required to remain on duty both day and night, add dignity to the service, and compel more respect from the general public for our forecasts.

## PROPOSED BUILDINGS.

It is planned to erect buildings at all places where the service is now represented and is paying rent for office quarters, if the population of the place is less than 25,000, and it is hoped that Congress will continue to appropriate a small amount for the purpose annually. It is found that when the population of a place is under 25,000 it is a difficult matter to get suitable accommodations, with good roof facilities, and as a result the accuracy of observations is often affected.

When our buildings are thus dotted over the country and equipped with modern self-registering apparatus we can truly say that the weather service of the United States is the finest in the world.

The following list shows the places under 25,000 population where the Government is now paying rent for Weather Bureau accommodations, and where buildings should be erected:

*Places where buildings should be erected.*

Place.	Popula- tion.	Rent paid.	Place.	Popula- tion.	Rent paid.
Abilene, Tex. ....	3,411	\$381.80	Moorhead, Minn. ....	3,730	\$265.25
Alpena, Mich. ....	11,802	211.86	Mount Tamalpais, Cal. ....	.....	420.00
Asheville, N. C. ....	14,684	300.00	Nantucket, Mass. ....	3,006	263.00
Baker City, Oreg. ....	6,688	450.00	North Platte, Nebr. ....	3,640	\$39.50
Birmingham, Ala. ....	24,000	720.00	Oklahoma, Okla. ....	10,037	510.00
Boise, Idaho. ....	5,957	480.00	Palestine, Tex. ....	8,297	314.00
Cape May, N. J. ....	2,257	420.00	Phoenix, Ariz. ....	5,544	480.00
Cheyenne, Wyo. ....	14,087	620.00	Pierre, S. Dak. ....	2,306	240.00
Columbia, S. C. ....	21,108	360.00	Pocatello, Idaho. ....	4,046	360.00
Concord, N. H. ....	19,632	300.00	Raleigh, N. C. ....	13,643	240.00
Concordia, Kans. ....	3,401	292.00	Rapid City, S. Dak. ....	1,342	378.00
Corpus Christi, Tex. ....	4,703	259.00	Red Bluff, Cal. ....	2,750	396.25
Dodge, Kans. ....	1,942	855.65	Roseburg, Oreg. ....	1,690	339.00
East Clallam, Wash. ....	32	72.00	San Diego, Cal. ....	17,700	\$84.00
Elkins, W. Va. ....	2,016	288.00	San Luis Obispo, Cal. ....	3,021	300.00
Escanaba, Mich. ....	9,549	540.00	Santa Fe, N. Mex. ....	5,603	420.00
Eureka, Cal. ....	7,827	368.80	Tampa, Fla. ....	15,839	328.75
Fresno, Cal. ....	12,470	378.00	Taylor, Tex. ....	4,211	575.00
Flagstaff, Ariz. ....	1,271	600.00	Twin, Wash. ....	.....	100.00
Grand Junction, Colo. ....	3,503	480.00	Valentine, Nebr. ....	811	420.00
Green Bay, Wis. ....	18,684	297.00	Walla Walla, Wash. ....	10,049	310.80
Helena, Mont. ....	10,770	588.00	Wichita, Kans. ....	24,671	340.00
Houghton, Mich. ....	3,359	375.00	Williston, N. Dak. ....	763	450.00
Huron, S. Dak. ....	2,793	500.00	Winnemucca, Nev. ....	1,000	265.00
Independence, Cal. ....	407	360.00	Wytheville, Va. ....	3,003	400.00
Kalispell, Mont. ....	2,526	270.00	Yankton, S. Dak. ....	4,125	800.00
Lander, Wyo. ....	737	351.00			
Lewiston, Idaho. ....	2,425	420.00	Total amount of rent- als. ....		21,089.16
Lynchburg, Va. ....	18,891	250.00	Total cost of buildings and sites ....		570,000.00
Marquette, Mich. ....	10,058	360.00			
Miles City, Mont. ....	1,938	300.00			

During the past several years Congress has authorized the construction of five or six observatories each year. It is recommended that the appropriation for this purpose be the same as last year, \$50,000.

## PRINTING AND PUBLICATIONS.

Printing of weather maps, forecast cards, meteorological forms, and bulletins was continued as usual.

The printing of postal cards decreased from 31,000,000 to 20,000,000, but the number of paper slips used in the distribution of forecasts by free rural carriers increased from 15,500,000 to 25,000,000.

Over 55,000,000 pieces of printed matter were sent out, of which 20,000,000 were prepared in the office of the Bureau; the remainder were printed at the Government Printing Office. In this number are included 8,500,000 station maps, one-half of which were printed at the Bureau.

The Monthly Weather Review has been given a complete new typographical dress and a fine quality of paper has been adopted, so that its mechanical appearance has been greatly improved.

A duplicate dynamo has been installed, and the efficiency of the engines has been increased by about 8 horsepower as a result of belting them direct to the generators.

## DIVISION OF SUPPLIES.

The operations of this division embrace the drawing of requisitions for supplies for the use of the Bureau; the receipt and inspection of the same; the drawing of transportation requests for transportation of supplies to and from stations; the examination of all accounts for purchase and transportation; the keeping of the record of all supplies received by purchase and otherwise, either in this city or at stations; the examination of property returns rendered annually, showing the accountability of observers for public property in their custody; the disposition of useless and condemned property, and the rendition annually of returns of all property used in the Bureau and for issue to stations. These duties have been well performed.

In accordance with plans made several years ago, and which have been generally put into effect, nearly all stations are now equipped with first-class standard furniture and equipment, thus putting the stations in a far better working condition than ever before.

## SUPPLIES AND EQUIPMENT FOR CENTRAL OFFICE.

In caring for the buildings and grounds occupied by the Weather Bureau in the city of Washington the additional sum of \$3,000 will be required during the next fiscal year. In 1894 the amount appropriated for this purpose was \$9,700 (including hire of laborers, \$2,800); in 1903 the amount was \$10,000, and for the present fiscal year it is \$6,000 (the salaries of the laborers previously on that roll, amounting to about \$4,000, having been transferred to the statutory roll of the office), from which it will be seen that the actual sum available for repairs and improvements to the buildings and grounds during the present fiscal year is less than it was eleven years ago, while the cost of materials has advanced and the buildings have deteriorated. The increased cost of fuel alone for the present year is about \$500, and the total amount required for fuel and gas is \$3,500, leaving only \$2,500 for repairs to the buildings and grounds, which is insufficient for the purpose. The main building is in need of extensive repairs to preserve it; the storehouses and annex buildings erected a few years ago now require repairs;

the engine room needs new boilers for burning hard coal, thereby complying with the District law in regard to smoke; and the grounds are also in need of improvements to preserve them, especially the old concrete roadways, which should be replaced. These matters have been deferred for several years, but now require attention.

In supplying the necessary furniture, stationery, and other supplies for the equipment of the central office the additional sum of \$3,000 will be required during the next fiscal year. In 1894 the amount appropriated by Congress for this purpose was \$13,700, since which time it has been reduced until now the amount is only \$8,000, a decrease of \$5,700 over the amount required eleven years ago, notwithstanding that during this period the service has expanded very much and the cost of supplies has increased from 20 to 30 per cent. Many of the rooms in the main building are in need of suitable office equipment, such as carpets, file cases, and other furniture, but it has been impossible to supply the same out of the small amount appropriated, which is barely sufficient to purchase the stationery required for ordinary office use.

#### PERSONNEL.

##### CLASSIFIED SERVICE.

**APPOINTMENTS.**—During the last fiscal year 95 appointments were made to the classified service, of which number 82 were of persons certified by the Civil Service Commission for positions with salaries ranging from \$360 to \$1,000 per annum; 5 were by transfer from other Departments, at salaries from \$630 to \$1,250 per annum, and 8 by reinstatement, at salaries from \$360 to \$1,250 per annum.

**PROMOTIONS.**—During the same period 83 promotions were ordered, all by advancement to the next higher grade.

In making these promotions the Secretary of Agriculture has not only recognized efficiency, but length of service as well. The 5 men promoted to the \$2,000 grade had served from eighteen to thirty-one years; the 4 promoted to \$1,800, from eight to twenty-seven years; the 1 promoted to \$1,600, twenty-five years; the 4 to \$1,500, eight to twenty-two years; the 1 to \$1,400, five years; the 5 to \$1,300, eight to eighteen years; the 13 to \$1,200, two to twenty-three years; the 12 to \$1,000, two to eight years; the 5 to \$900, two to nine years; the 1 to \$840, nine months; the 4 to \$720, five to eight years; the 2 to \$600, seven to eight years; the 24 to \$480, one to eight years, and the 2 to \$450, two to three years. It will be noted that no employee was promoted until he had served at least nine months in the lower grades; that no employee reached the \$1,600 grade until he had given eight years of service, while no promotion to \$2,000 was made until after a service of eighteen years.

**REDUCTIONS.**—During the year 19 reductions were ordered. Fourteen were due to the exigencies of the service (mostly changes of station assignments requested by the employee or necessitated by the public needs) and were without personal prejudice. Two were for laxness in the care and preparation of records, want of system in organizing and directing work, and generally unsatisfactory condition of station; 1 for neglect of duty and intemperance, and 2 for physical disability.



**RESIGNATIONS.**—There were 56 resignations, all but 2 voluntary. Nine were tendered by lower-grade employees who were examined and certified by the Civil Service Commission for higher positions in the Bureau. Of the 2 resignations requested, 1 was for intemperance and neglect of duty, and 1 for excessive absence with and without pay.

**REMOVALS.**—Seven discharges were made, all for cause, as follows: Intoxication, neglect of duty, and absence without leave, 1; unsatisfactory service, 4; absence without leave, 1; disobedience of orders, 1.

**DEATHS.**—Two deaths were recorded.

#### UNCLASSIFIED SERVICE.

But 4 appointments to the unclassified service were made during the year, and these were at salaries ranging from \$300 to \$600 per annum, and but 1 promotion was made, from \$600 to \$660, after a service of four years. There were 8 resignations, all voluntary, and no reductions.

The removals in the unclassified service numbered 8. One was without prejudice to the employee, his services being no longer needed (and his place remaining unfilled). Four were replaced by classified employees. Two were discharged for unsatisfactory services, and 1 for disobedience of instructions and absence without leave.

#### EMPLOYEES OF THE BUREAU.

The following shows the number and classes of employees of the Bureau, both those stationed at Washington, D. C., and those stationed outside of the city:

#### *Numerical strength of the Weather Bureau, July 1, 1903.*

At Washington, D. C.:		
Classified .....	162	
Unclassified .....	18	
		180
Outside of Washington, D. C.:		
Classified .....	479	
Unclassified .....	16	
		495
Total commissioned employees .....		675
Additional employees outside of Washington, D. C.:		
River observers .....	213	
Storm-warning displaymen .....	147	
Cotton region observers .....	140	
Corn and wheat region observers .....	132	
Rainfall observers .....	64	
Fruit and wheat region observers .....	20	
Sugar and rice region observers .....	9	
Total noncommissioned employees .....		725
Total paid employees .....		1,400
Voluntary observers .....		3,470
Voluntary crop correspondents .....		13,836
Total numerical strength .....		18,706

## SALARIES.

In the classified grades the highest salary per annum is \$3,000, the lowest \$360, and the average \$1,036.34. In the unclassified grades the highest salary per annum is \$720, the lowest \$240, and the average \$457.94. The compensation of employees at substations (storm-warning displaymen, river observers, etc.), ranges from 20 cents to 67 cents per day, and their hours of duty from twenty minutes to one hour per day. Public-spirited citizens, cooperating with the Bureau in the capacity of voluntary observers and crop correspondents, serve without compensation other than the receipt of such publications of the Department as may be of interest and value to them.

## THE EFFECT OF THE CIVIL-SERVICE LAW AND REGULATIONS.

It is a pleasure to report that both the letter and the spirit of the civil-service law and regulations have been fully complied with in the Weather Bureau, strict adherence to which has not only facilitated the transaction of business, but has produced a marked and steady improvement in the discipline and efficiency of this branch of the public service. It is rare to-day that any Weather Bureau employee seeks advancement by irregular methods, and this is due to the fact that it is well known to all connected with the Bureau that advancement may be secured solely through merit and efficiency.

Close attention has been given all rules of the Civil Service Commission, as promulgated from time to time, and I am able to report that there is no case in the Bureau of an unclassified employee performing duties that should be done by a classified employee. By reference to the foregoing tabular statement it will be noted that of 675 commissioned employees but 34 are unclassified. It is a significant fact that under the operations of a merit system that covers every employee in the Weather Bureau, the working force in its central office has actually decreased, while the volume of business has increased at least 20 per cent. In 1895 there were employed in the Weather Bureau at Washington 198 employees; on July 1, 1903, the number was 180, or a decrease of 18 in the working force.

## NEW STATIONS.

There are eight places at which full Weather Bureau meteorological stations should be established. At these places observations would be useful in the making of daily forecasts for the country at large, and there are important local interests that would be served; these places are important as distributing centers for daily weather maps and forecasts. I therefore recommend that \$20,000 be added to the appropriation for "General expenses" and \$20,000 to "Salaries," outside of Washington, which will be needed if these stations be established.

## RECAPITULATION OF INCREASES RECOMMENDED.

The increases in appropriations recommended in the foregoing report are as follows:

For improved daily weather maps:	
Material and supplies.....	\$35, 000
Salaries.....	20, 000

For extension of river and flood service:	
Material, supplies, and pay of observers.....	\$30,000
Salaries at central office.....	5,840
For climate and crop service: Salaries .....	750
For care of meteorological records: Salaries.....	4,400
For cables:	
South Manitou to North Manitou, Mich.....	2,000
Flavel, Oreg., to Fort Canby, Wash.....	15,000
Improvement of line between Cape Hatteras and Cape Henry, and its extension to Roanoke Island, North Carolina.....	10,000
For telegraphing observations and forecasts.....	50,000
For supplies and equipment for central office.....	3,000
For repairs to buildings and grounds at central office.....	3,000
For eight new stations:	
Supplies .....	20,000
Salaries.....	20,000
Total increase .....	<hr/> 218,990



## REPORT OF THE CHIEF OF THE BUREAU OF ANIMAL INDUSTRY.

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U. S. DEPARTMENT OF AGRICULTURE,  
BUREAU OF ANIMAL INDUSTRY,  
*Washington, D. C., September 15, 1903.*

SIR: I have the honor to submit herewith a report of the operations of this Bureau for the fiscal year ended June 30, 1903.

Respectfully,

D. E. SALMON, *Chief.*

Hon. JAMES WILSON, *Secretary.*

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### WORK OF THE YEAR.

#### OUTBREAK OF FOOT-AND-MOUTH DISEASE.

An unexpected outbreak of foot-and-mouth disease was discovered in Massachusetts and Rhode Island in November, 1902. The Department of Agriculture first received an intimation of the existence of this disease on November 14, 1902, in a letter from Dr. Austin Peters, chief of the cattle bureau of Massachusetts. This letter stated that a disease resembling foot-and-mouth disease had been discovered in Rhode Island, and that an investigation would be immediately made and the results reported. On November 17 Doctor Peters telegraphed that he believed the malady to be foot-and-mouth disease. Immediately upon receipt of this telegram, Dr. John R. Mohler, chief of the pathological division of the Bureau of Animal Industry, was sent to Massachusetts to investigate and report upon the disease existing in that section of the United States. Doctor Mohler reported, in a letter received November 24, that the disease was probably the European foot-and-mouth disease, and gave sufficient details as to symptoms and nature to allow an intelligent opinion to be formed. A calf and two sheep which he inoculated contracted the disease within two, four, and five days, respectively.

#### MEASURES TO PREVENT SPREAD OF THE DISEASE.

As there was no history of the introduction of affected animals into the United States, and a declaration of the existence of the disease would have such serious consequences in commercial restrictions, it was deemed advisable to have additional expert opinions. Dr. Leonard Pearson, dean of the veterinary department of the University of Pennsylvania, and Prof. James Law, dean of the New York State Veterinary College, were at once asked to proceed to Massachusetts and give an opinion as to the nature of the disease. Their joint report pronouncing the malady to be foot-and-mouth disease beyond doubt

was received November 27, and the quarantine order given herewith was promulgated the same day.

QUARANTINE OF CATTLE, SHEEP, AND OTHER RUMINANTS AND SWINE IN THE NEW ENGLAND STATES

U. S. DEPARTMENT OF AGRICULTURE,  
OFFICE OF THE SECRETARY,  
Washington, D. C., November 27, 1902.

*To the managers and agents of railroads and transportation companies of the United States, stockmen, and others:*

In accordance with section 7 of the act of Congress approved May 29, 1884, entitled "An act for the establishment of a Bureau of Animal Industry, to prevent the exportation of diseased cattle, and to provide means for the suppression and extirpation of pleuro-pneumonia and other contagious diseases among domestic animals," and the act of Congress approved June 3, 1902, making appropriations for the Department of Agriculture for the fiscal year ending June 30, 1903, you are hereby notified that the contagious disease known as foot-and-mouth disease exists among animals in the States of Connecticut, Rhode Island, Massachusetts, and Vermont, and that the cattle, sheep, and other ruminants and swine of said States have been exposed to the contagion of said disease: Therefore,

*It is hereby ordered,* That, to prevent the spread of the said disease from the States of Connecticut, Rhode Island, Massachusetts, and Vermont into other States or foreign countries, and to aid in its eradication, no cattle, sheep, or other ruminants or swine shall be moved or be permitted to move from or across the territory of any one of the States above named into any other State or foreign country. Any person, company, or corporation violating this order will be proceeded against as provided for by the act of Congress above referred to.

It is hoped that all transportation companies, cattle shippers, and others interested in the welfare of our animal industry will cooperate with the Department of Agriculture in enforcing this order, to the end that the restriction on traffic may have the desired effect and be removed in the shortest possible time.

JAMES WILSON, *Secretary.*

An order was also issued prohibiting the exportation of animals from the port of Boston, as follows:

PROHIBITION OF THE EXPORTATION OF CATTLE, SHEEP, AND OTHER RUMINANTS AND SWINE FROM THE PORT OF BOSTON.

U. S. DEPARTMENT OF AGRICULTURE,  
OFFICE OF THE SECRETARY,  
Washington, D. C., November 27, 1902.

Whereas a highly contagious disease, known as foot-and-mouth disease, exists among cattle in the State of Massachusetts, and the routes of transportation possibly may have been contaminated, and, in order to protect the export trade in live animals by preventing the exportation of animals which are diseased or which have been exposed to disease,

*It is hereby ordered,* That no cattle, sheep, or other ruminants or swine shall be permitted to be exported from the port of Boston until further orders.

JAMES WILSON, *Secretary.*

On the 1st day of December the writer went to Massachusetts to supervise and direct the Federal work of eradicating the disease. In the meantime a number of veterinarians in the service of the Bureau of Animal Industry in various parts of the country had been hurriedly summoned to Boston to supplement the local force. Dr. S. E. Bennett, the Bureau's chief inspector at Boston, was placed in charge of the force. Dr. F. A. Rich, of Burlington, Vt., was specially engaged and put in charge of the work in Vermont.

DISTRIBUTION OF THE DISEASE AND MEASURES FOR ERADICATION.

It appeared that the disease had existed in Massachusetts since August, and had extended over the eastern part of that State and into

Vermont, New Hampshire, and Rhode Island. At the time the Federal quarantine was declared the disease had not been discovered in Vermont, but its existence was strongly suspected. Investigation afterwards showed that a single center of contagion existed in that State, and that about 20 herds were affected. Four herds were subsequently found affected in New Hampshire, but as they were immediately slaughtered no general quarantine was placed upon that State at that time. Later, however, the disease was found to exist more extensively in New Hampshire, and on March 7, 1903, an order was issued quarantining that State. A careful investigation as to the condition of Connecticut failed to reveal any evidence of the disease, or anything to show that the contagion had existed there, and the quarantine on that State was therefore removed by an order dated December 22, 1902.

With such a comparatively wide distribution of the contagion at the time the disease was discovered, it was a serious problem to decide as to the best method of handling it in order to prevent the further dissemination of the disease and to guard so far as possible against the danger of its spread to other States. It was also important to take measures to prevent the escape of the contagion from control and its spread over the whole of the United States. At the time the Federal quarantine was established and the work of repression begun the disease was spreading very rapidly and new herds were daily becoming affected. In many instances there were several diseased herds in a single town or township.

After carefully considering the conditions which existed and the enormous loss with which the country was menaced by the spread of the contagion, it was decided to slaughter the diseased animals as soon as this could be done and to thoroughly disinfect the buildings in which they had been sheltered. As a basis of compensation an agreement was made with the governor of Massachusetts that the animals would be appraised at their value as if in good health and that 70 per cent of this appraisement would be paid as compensation to the owners by the Federal Government.

Great difficulty was experienced in disposing of the carcasses in a satisfactory manner, especially during the extremely cold weather, when it was very hard to dig trenches on account of the depth to which the ground was frozen. An effort was made to burn the carcasses, and this was successful in Vermont and at Barre, Mass. However, it was found that burning was a slow process where so many carcasses were to be handled and where fuel was more or less difficult to obtain. Accordingly, most of the carcasses were buried after the hides had been slashed and after they were covered with caustic lime.

The disease was so easily carried from stable to stable by persons that it was necessary to take special precautions to prevent its spread by the inspectors who must necessarily visit the diseased herds and who must make investigations of suspected herds. To avoid this danger so far as possible the inspectors were instructed to carry with them rubber caps, coats, and boots, which were to be worn while they were in the stables and sponged off with a disinfecting solution before they left the premises. In addition to this it was finally decided that the inspectors should also have rubber cloaks which would tie tightly around the neck and reach the ground, by the use of which the entire clothing might be disinfected in a few minutes by generating formalin with a suitable lamp placed under the cloak.



## DISINFECTION OF PREMISES.

The disinfection of many of the premises where the disease was found proved to be a laborious and difficult undertaking. Some of the barns and stables were old, much of the woodwork was more or less decayed, there were mows containing hay and other forage, grain and feed bins, double floors with much organic matter between, and manure cellars, some of which contained hundreds of loads of manure more or less frozen.

A number of disinfecting squads were organized, each containing eight men, provided with a force pump for spraying the disinfecting mixture and with other utensils necessary for carrying out the process of cleaning and disinfecting.

The first step in the process was to clean out all the loose litter, scrape the woodwork and remove all dust and filth, take up the floors, and remove the manure from the cellars. After this was done the whole place was saturated with a mixture of lime wash and chlorid of lime. During much of the time the temperature was below zero, and it was a difficult matter to keep the disinfectant from freezing before it could be applied.

It was necessary to disinfect some stables where the disease had been, but where all the animals had apparently recovered. These cattle were not killed, and it was found that the chlorid of lime gave a disagreeable flavor to the milk and prevented its use for some weeks after the disinfection of the stable. To obviate this the chlorid was dispensed with in such cases and formalin added to the whitewash in its place. It is doubtful if this is as efficient as the chlorid of lime, but no complaints were made of its damaging the milk cans or the milk, nor has any cause of dissatisfaction been found with the stables so disinfected.

## RECENT INTRODUCTION OF THE DISEASE INTO THE UNITED STATES.

It is not definitely known how the contagion was introduced into the United States in 1902, but the first herds affected were in Chelsea, Mass., in the vicinity of the docks, to which place the infection was no doubt carried from shipping. There are numerous channels by which it could have been introduced from Europe, where it has been very prevalent during the last fifteen or twenty years. Horses are continually being imported, with halters, ropes, forage, and bedding; small animals, such as goats, are often upon the ships, and fresh hides are also a constant article of commerce, and may come without sufficient disinfection from countries in which the disease exists. There are also imported large quantities of hair, wool, and other articles which might bring the contagion. As all cattle, sheep, and swine imported from European countries are placed in quarantine from fifteen to ninety days, it is impossible that the disease could have been brought with these animals without being recognized before they left the quarantine station.

## SLAUGHTER OF DISEASED ANIMALS INDORSED.

The slaughter of diseased animals has been frequently adopted as a means of combating the disease in Europe, and it has been more successful than any other measures. In fact, the International Veterinary Congress, held at Baden Baden in 1899, stated in one of its resolutions passed with reference to this disease that it was necessary to

authorize slaughter and to establish uniform sanitary regulations.<sup>a</sup> It is plain that in Europe the failure of efforts to control the disease by quarantine and isolation is recognized, and that the slaughter of diseased animals is looked upon as the most efficacious measure that can be adopted. The disease has frequently been stamped out by this method when first introduced into a country. If slaughter is justified and recommended in Europe, where the disease so frequently occurs and is so prevalent, how much more is it to be recommended in a country like the United States, where it is confined to a very small territory and where there is such an enormous number of animals to be affected by it if it spreads beyond control.

#### NATURE AND CHARACTERISTICS OF THE DISEASE.

Foot-and-mouth disease is a highly contagious malady affecting ruminating animals (cattle, sheep, goats, deer) and hogs. No specific germ has yet been identified as the causative agent. In general the disease begins with an elevation of temperature amounting to from 2° to 6° F. and the formation of vesicles in the mouth, upon the udder and teats, and on the feet. These vesicles are of various sizes, the epidermis being raised by a clear exudate, which soon escapes by the rupture of the membrane. The membrane covering the vesicles is torn away by abrasion of the parts or hangs in shreds, leaving a raw, ulcerated surface which is extremely sensitive. When the vesicles appear in the mouth there is considerable salivation, the saliva gathering in a white foam about the mouth and attracting the attention of the observer. This is one of the first symptoms, and the salivation may be so abundant as to saturate the hay and floor in front of the affected animal. Affected cattle may also make a peculiar smacking sound with the mouth, which is no doubt due to the soreness of the tongue or adjacent parts. When the disease is severe the vesicles in the mouth may be as large as a silver dollar; sometimes the whole mucous membrane appears congested and the epithelium loosened. When the tongue has been seized by the inspector to hold it while examining the mouth, the membrane has sometimes been stripped off by his hand, leaving the organ raw and bleeding and causing the animal the most acute suffering.

When the vesicles appear about the feet the animals may be seen to raise and shake the posterior extremities in a manner which indicates the pain that they feel in the affected regions. Large vesicles appear upon the udder and teats, which interfere seriously with milking, and from which secretions issue which may contaminate the milk at the time it is drawn. There is often congestion of the mammary glands, with induration and the formation of abscesses.

The acute stage of the disease is generally terminated within a period of two weeks, after which time convalescence occurs with more or less rapidity, according to the conditions of existence and the extremes of temperature to which the animals are subjected.

#### LOSSES BY THE DISEASE.

The disease is not one which produces a high fatality. The average loss by death in European countries has been from 2 to 5 per cent. The actual losses of cattle owners are, however, much greater than this.

<sup>a</sup>Seventh International Congress of Veterinary Surgeons. Baden-Baden, 1899. Vol. II, p. 518.

The high fever causes a rapid loss of flesh, which loss is augmented by the fact that owing to the large vesicles and resulting ulcers in the mouth the animals are not able to masticate their food. On account of this loss of flesh their value is decreased from 20 to 25 per cent. At the same time the milk secretion almost disappears and the owner loses all revenue from his animals for from four to six weeks.

When the animals have recovered from the acute form of the disease many of them are found to be more or less injured, some of them having lost the horn from their feet, others having ulcers of the feet which cause chronic lameness, a considerable proportion having abscesses in the udder, which make them worthless for milk production, while numerous others abort and become emaciated and of little value. On the whole, it is probably not far from correct to estimate that in an outbreak such as the present one in the New England States the average loss on account of the disease equals 50 per cent of the value of the cattle affected.

However, there is no disease in which different outbreaks vary more in their virulence than foot-and-mouth disease. In some outbreaks the cattle suffer but little, scarcely an animal dies, and the contagion spreads very slowly or dies out in a short time. In other outbreaks 50 per cent of the cattle may die, the disease is very contagious and spreads rapidly, and the contagion is carried long distances in the clothing of persons and in the hair of animals.

#### CONDITIONS IN MASSACHUSETTS.

In Massachusetts a number of herds were preserved which had the disease in a mild form and which had apparently recovered at the time the inspection was made. In about one-third of these cases the owners afterwards came in with the statement that a relapse had occurred with their animals; some were again affected with the formation of vesicles, and most of the others had abscesses in the udders, which made them unfit for milk production. At the time these cattle were slaughtered the udders of many of them were so distended with pus that they were ruptured as the animals fell, and discharged vast quantities of this liquid.

The present outbreak in Massachusetts has been a very virulent one. The disease has spread with extreme facility and has affected all of the cattle in the infected herds within a very few days, while the fever has been very high, the loss of flesh extreme, and the after results very unfavorable.

#### LIABILITY OF HUMAN BEINGS TO THE DISEASE.

The communication of the disease to people using the milk of diseased animals has been frequently reported in European outbreaks. With children especially the disease produced in this manner is quite serious and sometimes fatal. A few cases of this kind were reported during the Massachusetts outbreak, but they were not investigated, and it is not positively known that the disease affecting the people was identical with that of the cattle. In this outbreak the sale of milk was stopped as soon as the disease was found upon a place, and for that reason there was not the opportunity for the infection of mankind which exists when an outbreak is more extended and affects practically all the milk-producing animals of a country. However, people



were advised to pasteurize the milk which they used, and thus avoid any possibility of infection.

#### DIFFICULTIES OF CONTROL.

With about one hundred herds already affected when the Department began active operations for eradicating the disease, and with new cases appearing daily, it was a matter of impossibility to dispose of all the diseased animals at once. The severe weather impeded the work considerably, and for a time it seemed that new cases were developing faster than the old ones could be put out of the way. In order to get the outbreak under control and to prevent, so far as possible, the spread of the disease, the general plan was adopted of slaughtering first the herds on the outskirts of the infected district and then working toward the center, thus restricting and gradually lessening the area of infection. As a result, there was very little extension of the disease beyond the territory affected when the work was commenced, and the spread of the contagion was soon checked. Within thirty days the force had so far caught up with the work that it was possible to dispose of every newly affected herd soon after it was reported, and by the end of January, 1903, practically all the diseased animals had been destroyed, so far as then known to the Department.

The progress of the work, especially in Massachusetts, demonstrated in a striking manner the efficacy of slaughter and the futility of relying upon quarantine alone in stamping out the disease. Just so long as any considerable number of diseased herds remained alive, giving off contagion which might be disseminated by people, dogs, cats, rats, chickens, and pigeons, and possibly through other agencies, in spite of the local quarantines, so long did the disease continue to spread rapidly. And as the number of herds which were the sources of contagion was reduced the spread of the disease was proportionately diminished and arrested.

It is unfortunate, however, that in Massachusetts and New Hampshire the withholding of information and the failure to report the disease to the authorities, and the evident intention of some of the people to conceal it, have resulted in prolonging the period of infection and the time for which the quarantine was necessary. When it was supposed that the disease had been eradicated, a house-to-house inspection was instituted in Massachusetts in order to make sure that the contagion no longer existed, and this inspection revealed a number of herds still affected. Early in March the disease was found among a lot of 11 cattle received at Watertown, Mass., from Bedford, N. H., and an investigation at the place of origin disclosed quite a number of affected herds throughout the neighboring townships. These discoveries necessitated a thorough canvass of the whole infected district, which required considerable time and resulted in the finding of other diseased herds from time to time in Massachusetts and New Hampshire, though no more were found in Vermont and Rhode Island.

Some of these herds bore evidences of having been affected for some weeks. Every day that such a herd was held by its owner without reporting it gave opportunities for the spread of the infection and also lengthened the period of quarantine. If all such cases had been promptly reported, the disease could have been entirely eradicated within a few months and the affected States relieved from the quarantine restrictions which weighed so heavily upon the farming and com-

mercial interests, but on account of the concealment of the disease it has been necessary to maintain the quarantine for at least twice the period which would otherwise have been required.

#### SUPPLEMENTAL ORDERS RELATIVE TO QUARANTINE.

In accordance with the developments of the situation from time to time various orders and regulations were issued. On November 29, 1902, the quarantine was modified so as to permit the shipment, for immediate slaughter, of animals from outside the quarantined district across and into that district, under certain restrictions as to sealing of cars, inspection, etc. This was done to avoid, so far as possible, interference with the meat supply of the infected district. On December 13 an order was issued providing for the disinfection and return of stock cars from outside the infected territory, and also placing a quarantine upon hides and other products of susceptible animals in the quarantined States. On January 23 and February 2, 1903, amendments were issued permitting the shipment of animals from Vermont to certain points in Massachusetts, in certain cases and under certain restrictions, and allowing certain animal products to be taken out of Vermont. On March 7 the State of New Hampshire was placed in quarantine, on the discovery of further infection, as heretofore stated.

An act of Congress giving to the Secretary of Agriculture greater powers in dealing with contagious diseases of animals having been approved February 2, 1903, a new quarantine order covering the State of Massachusetts was issued on April 15, so as to bring the regulations under the authority conferred by that legislation. On May 1 the quarantine was removed from Vermont, with the exception of certain townships in and near which the disease had existed, and provision was made for animals to be released from these townships on inspection and permit. On May 9 the quarantine was removed from Rhode Island. On May 12 an order was issued providing for the movement of animals from Vermont into Massachusetts across New Hampshire for purposes other than immediate slaughter, from New Hampshire into Massachusetts for immediate slaughter at certain points, and from Massachusetts into New Hampshire for pasturage in certain cases and under certain restrictions. An arrangement was also made for issuing permits allowing persons whose farms were located partly in one State and partly in another to move their animals across the State line within the limits of their farms.

#### SEVERE PRECAUTIONARY MEASURES NECESSARY.

Owing to the treacherous nature of the foot-and-mouth disease and to the ease and rapidity with which the contagion spreads, it has been necessary to take the utmost precautions and to guard every channel by which there seemed to be a possibility of the contagion escaping to other parts of the country; and while the restrictions have caused some hardship and may have seemed unduly severe to some persons, they have been no more rigorous than was considered necessary to accomplish the object in view, and they have been relaxed or removed just as soon and to such an extent as it appeared could be done with safety.

The effect of the quarantine on animal products was to prevent for a time the shipment of a large quantity of hides and wool, to the

great inconvenience of the trade. The Department felt justified, however, in taking strict measures with regard to interstate traffic in such articles. If there was a single infected hide among a large lot, or if the wool from a single diseased sheep had been mixed with a large amount from healthy sheep, there was still some danger of the contagion being carried by these products. The contagion was most probably introduced into the United States by some article or material which had been exposed to infection, and not by diseased animals themselves; and there was just as much probability that it might be conveyed to other parts of the United States in a similar manner. In order to relieve the situation as much as possible, a thorough investigation was made into the origin, history and condition of storage of the stocks of wool and hides, and in cases where it could be clearly shown that the products had come from uninfected sections and had not been exposed to contagion they were released for shipment.

In making investigations of this character and in supervising the movements of animals and animal products there was involved a vast amount of work besides that relating directly to the eradication of the disease.

SCIENTIFIC EXPERIMENTS NOT PERMITTED.

No scientific investigations or experiments were conducted by the Department with the exception of the inoculation tests made soon after the discovery of the disease for the purpose of confirming the diagnosis. Foot-and-mouth disease has been the subject of investigation and study by scientists in Europe and in other parts of the world for many years, and it was considered doubtful if any new scientific facts concerning its nature could be brought to light during the brief period to which it was hoped its presence in this country would be limited. There was some danger that the propagation of the disease for experimental purposes might result in the escape of the contagion beyond control. Although members of the scientific staff of the Bureau and others were desirous of making some investigations, it was decided that the risk was too great and the chance of accomplishing any good results too remote for this to be permitted.

NUMBER OF ANIMALS AFFECTED, NUMBER SLAUGHTERED, COMPENSATION PAID, ETC.

The tables which follow show the number of herds and animals found affected with foot-and-mouth disease, the number slaughtered, the compensation paid, etc. These figures include all the animals in the infected herds, whether they showed symptoms of the disease or not. As in an outbreak of this disease all the animals exposed contract it in the course of a week or two, it was assumed that where one or more animals in a herd showed clear evidence of the disease all the rest were affected.

The difference between the number of cattle affected (4,712) and the number slaughtered (3,872) represents those that either died or recovered. Nearly all the recoveries were in the early cases, where the disease had run its course before the work of slaughtering was begun or before those herds could be reached. After the commencement of the work of eradication no newly affected herds were allowed to be held for recovery.



*Number of herds and cattle affected with foot-and-mouth disease since the beginning of the outbreak, as reported by months.*

Month.	Massachusetts.		New Hampshire.		Vermont.		Rhode Island.		Total.	
	Herds.	Cattle.	Herds.	Cattle.	Herds.	Cattle.	Herds.	Cattle.	Herds.	Cattle.
November, 1902 <sup>a</sup> .....	62	1,219	.....	.....	4	47	7	234	73	1,500
December, 1902.....	71	1,536	4	37	17	288	8	110	100	1,971
January, 1903.....	9	225	.....	.....	.....	.....	.....	.....	9	225
February, 1903.....	6	196	.....	.....	1	16	3	16	10	228
March, 1903.....	3	55	28	444	.....	.....	.....	.....	31	499
April, 1903.....	3	9	15	221	.....	.....	.....	.....	18	230
May, 1903.....	2	28	1	31	.....	.....	.....	.....	3	59
Total.....	156	3,268	48	733	22	351	18	360	244	4,712

<sup>a</sup>These are the figures of official record, but it is known in a general way that there were more animals affected previous to November.

*Cattle, hogs, sheep, and goats slaughtered by United States Department of Agriculture.*

State.	Herds.	Cattle.	Hogs.	Sheep and goats.	Total animals.
Massachusetts.....	129	2,708	229	55	2,992
New Hampshire.....	48	733	68	100	901
Vermont.....	22	351	55	74	480
Rhode Island.....	6	80	8	.....	88
Total.....	205	3,872	360	229	4,461

*Appraised valuations and compensation paid for animals slaughtered.*

States and animals.	Number.	Appraised value on health basis.	Average per head.	Net compensation (70 per cent).	Average per head.
<i>Massachusetts.</i>					
Cattle (not including calves).....	2,589	\$131,238.58	\$50.69	\$91,867.00	\$35.48
Calves.....	119	1,021.79	8.59	715.25	6.01
All cattle.....	2,708	132,260.37	48.84	92,582.25	34.19
Hogs.....	229	2,269.43	9.91	1,588.60	6.94
Sheep and goats.....	55	444.00	8.07	310.80	5.65
Total.....	2,992	134,973.80	.....	94,481.65	.....
<i>New Hampshire.</i>					
Cattle (not including calves).....	668	28,704.00	42.97	20,092.80	30.08
Calves.....	65	539.00	8.29	377.30	5.80
All cattle.....	733	29,243.00	39.90	20,470.10	27.93
Hogs.....	68	574.50	8.45	402.15	5.91
Sheep.....	100	497.00	4.97	347.90	3.48
Total.....	901	30,314.50	.....	21,220.15	.....
<i>Vermont.</i>					
Cattle (not including calves).....	301	.....	.....	9,348.00	31.06
Calves.....	50	.....	.....	590.00	11.80
All cattle.....	351	.....	.....	9,938.00	28.31
Hogs.....	55	.....	.....	429.32	7.81
Sheep.....	74	.....	.....	325.75	4.40
Total.....	480	.....	.....	10,693.07	.....
<i>Rhode Island.</i>					
Cattle (not including calves).....	79	3,523.00	44.59	2,466.10	31.22
Calves.....	1	3.00	3.00	2.10	2.10
All cattle.....	80	3,526.00	44.08	2,468.20	30.85
Hogs.....	8	65.00	8.12	45.50	5.69
Total.....	88	3,591.00	.....	2,513.70	.....

*Appraised valuations and compensation paid for animals slaughtered—Continued.*

## SUMMARY.

Animals.	Number.	Net compensation.	Average per head.
Cattle (not including calves).....	3, 637	\$123, 773. 90	\$34. 03
Calves.....	235	1, 684. 65	7. 17
All cattle.....	3, 872	125, 458. 55	32. 40
Hogs.....	360	2, 465. 57	6. 85
Sheep and goats.....	229	984. 45	4. 30
Total compensation paid.....		128, 908. 57	

## INSPECTIONS UNDER QUARANTINE REGULATIONS.

The inspection division reports that, under the requirements of the quarantine regulations, there were issued, from February to June, 9,699 permits for the removal of wool and hides; that from December to June, 4,654 cars were cleaned and disinfected in the quarantined States; that 10,348 empty cars were sealed without disinfection and returned to the West; that 12,618 cars carrying live stock from the West into or through the quarantined States were sealed.

## A VENEREAL DISEASE OF HORSES, THE SO-CALLED MALADIE DU COÏT.

The work in this connection has been vigorously prosecuted during the year under the immediate direction of the miscellaneous division, and at its close we are encouraged to hope through what has been accomplished that it will eventually, and not at a very remote period, be entirely stamped out. Numerous obstacles to the accomplishment of this end have been found quite difficult to overcome, among which may be mentioned the semiwild condition of much of the country over which the disease had spread, the wild state in which most of the animals existed, and the lack of cooperation and aid given by owners throughout the worst infected sections, these being in and adjacent to the Indian reservations of South Dakota. Previous to the annual round-up season on the ranges in and about the Pine Ridge and Rosebud Indian reservations organized preparations were made for the inspection of all the horses owned by the Indians and others in the territory named. Inspection camps were inaugurated, one for each of the several districts throughout the reservations. This arrangement made possible the inspection of practically all horses running at large on these ranges; thus the advantages to be gained in a great part were availed of, and animals which habitually ran at large on the open range, a great majority of which had never been handled, were subjected to careful veterinary examination, as in the case of those usually kept in barns or inclosed pastures.

During the round-up season from June 1 to June 30, 1903, 9,455 horses were examined; 173 were slaughtered because of showing evidences of the disease, 6 of which were stallions and 167 mares. In addition, 1,270 stallions running at large, these being the most effective spreaders of the disease, were castrated, and 185 stallions to be used for breeding purposes were tagged for identification. During the year the total number of animals inspected was 16,287; number found diseased and slaughtered, 511; number quarantined as suspicious, 277; number stallions castrated, 1,889. The average price paid by the

Department for 474 animals slaughtered because of being diseased was \$17.52, amounting to \$8,308, leaving 37 animals to be paid for, owners unknown at present or settlement in course of adjustment. Castrations, having been performed by employees of the Bureau, incurred no expense, and because of this operation the possibility of the transmission of the disease through the animal operated on was removed.

Under date of January 20, 1903, the Secretary of Agriculture issued an order prohibiting the transportation or movement of any horses in the counties of Dawes, Box Butte, Sheridan, and Cherry, in the State of Nebraska, and in the Pine Ridge and Rosebud Indian reservations and the counties of Custer and Fall River, S. Dak., to any other State or Territory or the District of Columbia unless first inspected by an inspector of this Bureau and accompanied by a certificate issued by the said inspector.

On March 10, 1903, the Secretary of Agriculture, with the concurrence of the Secretary of the Interior, issued an order which was posted throughout the above-named Indian reservations, prohibiting any stallion or stallions from running at large within the bounds of these reservations, also directing that any uncastrated male horse one year of age or older found running on the range or at large in these reservations be castrated, and that all stallions belonging to owners living on White Clay Creek or within 1 mile thereof should either be castrated or kept under close quarantine until further orders; also prohibiting, furthermore, the breeding of horses in herds in which diseased animals had been found, under any circumstances, whether in fenced pastures, inclosures, or otherwise, and directing, with a provision for appraisement and indemnity to owners, that any animal or animals showing symptoms of *maladie du coït*, or known to have been exposed to the disease, shall, in the discretion of an inspector or employee of this Department, be immediately quarantined, and maintained in quarantine at the expense of the owner or owners until released by the inspector or condemned and slaughtered, with a statement to the effect that any person, company, or corporation knowingly violating the provisions of this order is guilty of a misdemeanor, and on conviction liable to a fine of not less than \$100 nor more than \$1,000, or to imprisonment not more than one year, or to both such fine and imprisonment.

As a result of the work that has been done during the year and the thoroughness of method which has obtained in its prosecution, we are encouraged to believe that the disease in the counties of Box Butte, Dawes, Sheridan, and Cherry, Nebr., is practically stamped out. Numerous herds in which the disease has been found in these counties are being kept under surveillance, and while it seems almost inevitable that a case here and there may occur, we feel that the Bureau now has the disease well in hand and under control. The last remark applies likewise to the Indian reservations, as all stallions left for breeding purposes are tagged with a quarantine tag, kept under quarantine restrictions, and regularly inspected, so that should the disease develop at any point it will be promptly detected, which should not admit of a possibility of its spread. In the counties of Custer and Fall River, S. Dak., the disease was introduced and disseminated by an irresponsible class of horse traders who made it their business to procure Indian ponies from the reservations and trade them off to settlers living on adjacent territory. The disease here, fortunately,



is not very prevalent, but all stallions have been ordered off the range, and in most instances there has been compliance on the part of owners. This range is very difficult to work, owing to its mountainous character, notwithstanding which the inspector in charge states that in all territory known to be infected the disease is well in hand, and the usual conservatism of this inspector, Dr. E. T. Davison, in making statements of this character, leads to the belief that it will not again get beyond control at any point, but, on the contrary, will ultimately, and not at a very distant date, be entirely stamped out.

Investigations and experiments have been continued throughout the year at the pathological laboratory and at the experiment station of this Bureau, under the direction of Dr. John R. Mohler, chief of the pathological division, by means of specimens consisting of diseased organs and a diseased living mare brought from the infected section of country to Washington, D. C. Doctor Mohler has likewise on two occasions visited the infected country for the purpose of making personal observations of the malady as it occurs there in its various phases. It is expected, therefore, that in the course of the fiscal year upon which we are about to enter the results of the work that has been done in this connection, together with the technique followed in its prosecution, may be issued in bulletin form for the information of those interested in this important subject from an economic as well as from a scientific standpoint.

#### TUBERCULOSIS.

During the past year the work which was begun in the biochemic division in the spring of 1902 to determine the infectiousness of human tuberculosis for cattle has been completed. The results show that of 9 freshly isolated cultures of human tuberculosis from various sources, 2 were fully equal to a freshly isolated bovine culture in their pathogenic power for cattle, and in addition possessed no cultural or morphological characters sufficiently marked or constant to permit of a distinction being made between them and the organism of bovine origin. Both of these virulent human cultures were derived from children who died of generalized tuberculosis. It is interesting to note that among the 4 cultures obtained from children, 2, or 50 per cent, were quite the equal of the bovine bacillus in their pathogenic power for cattle. All of these cultures have been carefully compared with reference to their virulence for cattle, hogs, rabbits, and guinea pigs. Steps have been taken to push to completion experiments which were begun in 1894 by Doctor de Schweinitz, chief of the biochemic division, and in which he apparently succeeded in establishing considerable immunity from tuberculosis in cattle by a previous inoculation with attenuated human tubercle bacilli. If this work proves to be successful in a practical way, it may be of great benefit to the cattle raisers of this country. In connection with other work, experiments have been inaugurated whereby it is hoped to obtain a method for cultivating rapidly, from sputum, tubercle bacilli which are so few in number as to escape detection by a microscopic examination. Such a method would be of great value in the diagnosis of doubtful cases of tuberculosis.

The question of the infectiousness of mammalian tubercle bacilli for fishes has also been taken up and is being studied experimentally, but this work is as yet incomplete. The experiments looking to the production of an antitoxic serum for tuberculosis are being continued.

During the fiscal year just ended the biochemic division has prepared and sent out free of charge to health officers 47,358 doses of tuberculin, apportioned among the different States and Territories as follows:

*Distribution of tuberculin.*

	Doses.		Doses.
California.....	558	Montana.....	996
District of Columbia.....	438	New Jersey.....	2,121
England.....	900	New York.....	111
Georgia.....	18	North Carolina.....	390
Illinois.....	6	North Dakota.....	192
Iowa.....	202	Ohio.....	378
Kansas.....	147	Oregon.....	132
Kentucky.....	30	Vermont.....	10,818
Maine.....	104	Virginia.....	78
Maryland.....	360	Washington.....	396
Massachusetts.....	5,832	West Virginia.....	36
Michigan.....	249	Wisconsin.....	1,008
Minnesota.....	21,732		
Mississippi.....	126	Total.....	47,358

The comparative study of tubercle bacilli from differing sources, which was inaugurated by the pathological division last year, has been pursued throughout the present fiscal year, but, owing to the adoption of the subcutaneous method for the inoculation of the experimental animals and the slow growth of the organism of tuberculosis, both upon culture media and in the inoculated animal, the work will not be completed for some time.

As the result of the appearance of a gastro-intestinal disturbance in endemic form among the midshipmen of the United States Naval Academy last winter, and which was traced to the milk supply, the commandant of the Academy requested the cooperation of this Bureau with the view of adopting such measures as would prevent a repetition of the trouble. A visit to the farm which supplied the milk to the students revealed a highly unsanitary condition of the premises and the presence of certain cows in the herd which exhibited clinical evidence of tuberculosis. The offending features in the stable, well, and dairy house were corrected and the tuberculin test applied to the herd of 62 animals, 36 of which reacted. The tubercular cattle were subsequently slaughtered at a Baltimore abattoir, under the supervision of an official of this Bureau, and the diagnosis made by the tuberculin test was confirmed.

Tuberculosis was studied from many different sides at the experiment station of the Bureau and a number of important conclusions reached. It was shown that tubercle germs from human sources, on subcutaneous injection, frequently, but not always, fail to produce generalized tuberculosis in cattle; that tubercle germs which fail to cause tuberculosis in cattle on subcutaneous injection produce local abscesses, in which the tubercle germs retain their virulence for long periods of time; that tubercle germs which cause progressive tuberculosis in cattle on subcutaneous injection do not produce abscesses, but, on the contrary, cause typical tubercular lesions at the seats of injection; that cattle which have been exposed to tubercular infection, either by injection or feeding, may react positively to tuberculin for a considerable period of time, even when no lesions of disease, attributable to the exposure, can be detected by the most careful post-

mortem examination; that intravenous injections of tubercle germs of a kind which do not possess the power to produce a typical tuberculosis in the subjects injected cause an extensive disease, especially in the lungs, which gradually ends in recovery. It is not known how long virulent tubercle germs remain in the tissues of these seemingly recovered animals, but from some observations made at the station it is fair to assume that germs are still present long after apparently perfect health has been reestablished. In one instance human germs injected into the udder of a cow, through the teat, caused a disease which disappeared after several months, but the material which was taken from the udder a year later still caused fatal, generalized tuberculosis in guinea pigs on subcutaneous injection.

One experiment made at the station regarding the rapidity with which tuberculosis may spread in a herd of cattle upon the introduction of a tubercular cow deserves special attention. In a stable containing 10 box stalls, with high 2-inch plank walls, 7 healthy cattle were confined with 3 tubercular cows. Two of the healthy cattle occupied the same stalls constantly and 5 frequently occupied stalls previously used by the tubercular cattle. After six months 6 of the 7 healthy cattle had contracted tuberculosis. The seventh animal, which escaped, had received vigorous preventive treatment before it was exposed. The 2 animals which at no time entered the stalls infected directly through being occupied by diseased cattle were among the 6 animals which became affected. This experiment shows the great care which must be exercised against the introduction of tubercular cattle into healthy herds, and that a healthy herd may become entirely tubercular, if the proper precautions are neglected, in a very short time.

#### TUBERCULIN TEST IN ENGLAND.

The official veterinarian stationed at London, England, in accordance with the requirements of Bureau of Animal Industry Order No. 79, dated November 10, 1900, providing for the testing with tuberculin, by an inspector of this Bureau, of all cattle over 6 months old which are to be imported into the United States, has tested of the different breeds of pure-bred cattle in various parts of Great Britain 631 cattle, of which 533 passed and 98 were rejected, as follows:

#### *Results of tuberculin test of cattle in England for importation.*

Breed of cattle.	Passed.	Rejected.	Breed of cattle.	Passed.	Rejected.
Shorthorn .....	91	29	Dexter Kerry.....	18	0
Jersey .....	151	23	Highland.....	16	a 3
Aberdeen-Angus .....	89	33	Sussex.....	1	0
Guernsey.....	33	2			
Hereford .....	105	2	Total .....	533	98
Galloway.....	29	6			

a Tested in United States quarantine station.

In view of the fact that tuberculosis has not been found to occur among the native cattle on the islands of Jersey and Guernsey, the cattle to be imported directly from these islands into the United States were exempted from the tuberculin test by amendment No. 12 to Bureau of Animal Industry Order No. 56, dated October 25, 1902.



## RABIES.

The continuous existence in the District of Columbia of the contagion of rabies, a disease which is capable of being controlled only by the enforcement of proper regulations, is a serious condition, and methods for its suppression are worthy of serious consideration at the present time. Not since 1900, when rabies was so prevalent in this vicinity, has such a large number of rabid animals been referred to this Bureau and investigated by the pathological division. During the past year fifty-one investigations for the purpose of determining the presence or absence of rabies in various animals were made. The animals included in the above consisted of 37 dogs, 6 cattle, 2 horses, 1 fox, 3 wolves, 1 bear, and 1 rabbit, the latter having bitten a small girl. Of these, 38 gave positive results, either by animal inoculations or by the microscopic examinations of sections of the plexiform ganglia. The latter method has proved very valuable, as a diagnosis can be usually made within forty-eight hours; but the ganglion should be perfectly fresh, owing to the histological changes being obliterated when putrefaction occurs. The 29 cases below recorded as originating in the vicinity of Washington, D. C., can not be considered as representing the extent of rabies in the District of Columbia, since distinctive cases frequently occur in the practices of local veterinarians, the diagnoses of which require no confirmation. It is only those cases which are atypical, or where persons have been bitten, or owners skeptical of the diagnosis, that the Bureau is called upon to investigate. It will be further noticed that an unusual percentage of the cases received proved to be rabid. This is due to the fact that only those animals showing a fairly characteristic history of rabies, or where the animal had been vicious and bit other animals or persons, or for obviously interesting reasons, were used for diagnostic purposes. This method of procedure was decided upon, as the labor involved on unimportant cases with doubtful histories did not seem to be justified. The following positive results have been obtained from suspected cases of rabies:

*Results of inoculation tests and microscopic examinations for rabies.*

Date.	Record No.	Kind of animal.	Received from—	Rabbits inoculated.	Result of inoculations.	Diagnosis by histological examination.	Persons or animals bitten.
1902.							
July 3	254	Dog ..	Balls Hill, Va .....	2	Positive ....	None made.	2 dogs.
July 16	255	..do..	Dist. Columbia .....	2	..do .....	..do .....	
July 20	257	Cow ..	..do .....	2	..do .....	..do .....	
Aug. 1	258	Dog ..	Fort Myer, Va .....	2	..do .....	..do .....	
Aug. 12	260	..do..	Dist. Columbia .....	2	..do .....	..do .....	Do.
Aug. 23	261	..do..	..do .....	2	..do .....	..do .....	Boy and dog.
Sept. 11	262	Fox ..	..do .....	2	..do .....	..do .....	
Sept. 12	263	Dog ..	..do .....	2	..do .....	Positive .....	Girl.
Oct. 1	265	..do..	..do .....	2	..do .....	..do .....	Woman.
Oct. 22	268	..do..	Easton, Md. ....	2	..do .....	..do .....	
Nov. 3	269	..do..	Dist. Columbia .....	2	..do .....	..do .....	
Nov. 7	270	..do..	..do .....	2	..do .....	..do .....	Boy.
Nov. 11	271	Cow ..	..do .....	2	..do .....	None made.	
Nov. 21	272	Dog ..	..do .....	2	..do .....	Positive .....	3 men.
Nov. 29	273	..do..	..do .....	2	..do .....	..do .....	Girl.
Dec. 12	274	Steer ..	Atoka, Ind. T. ....	2	..do .....	None made.	
Dec. 13	275	Cow ..	Boston, Va .....	2	..do .....	..do .....	
Do....	277	Horse.	Frankfort, Ind .....	2	..do .....	..do .....	
Dec. 30	279	Wolf..	Dist. Columbia .....	2	..do .....	Positive ....	

*Results of inoculation tests and microscopic examinations for rabies—Continued.*

Date.	Record No.	Kind of animal.	Received from—	Rabbits inoculated.	Result of inoculations.	Diagnosis by histological examination.	Persons or animals bitten.
1903.							
Jan. 10	280	Dog ..	Dist. Columbia .....	3	Positive ....	None made.	2 dogs.
Jan. 17	281	Wolf ..	..do .....	2	..do .....	..do .....	
Jan. 22	282	Dog ..	Biltmore, N. C. ....	2	..do .....	Positive .....	2 men.
Jan. 23	283	..do ..	Dist. Columbia .....	2	..do .....	..do .....	1 man and 2 dogs.
Feb. 6	284	..do ..	..do .....	2	..do .....	None made.	
Feb. 20	286	Wolf ..	..do .....	2	..do .....	..do .....	
Mar. 30	289	Dog ..	..do .....	2	..do .....	Positive .....	Boy.
Apr. 14	290	..do ..	..do .....	2	..do .....	..do .....	Do.
Apr. 17	291	..do ..	..do .....	2	..do .....	..do .....	Do.
Apr. 20	292	..do ..	Philips Hill, Md. ....	2	..do .....	..do .....	Do.
Apr. 21	293	..do ..	Dist. Columbia .....	2	..do .....	..do .....	
May 11	294	..do ..	..do .....	2	..do .....	..do .....	
May 13	295	Steer ..	Shepherdstown, W. Va. ....	2	..do .....	None made.	
May 16	296	Dog ..	Dist. Columbia .....	2	None made.	Positive .....	3 persons.
June 5	299	..do ..	..do .....	2	Positive .....	..do .....	
June 9	300	..do ..	Norfolk, Va. ....	3	..do .....	..do .....	Man.
June 10	301	..do ..	Dist. Columbia .....	2	..do .....	..do .....	Boy.
June 24	302	..do ..	Norfolk, Va. ....	2	None made.	..do .....	
Do....	303	..do ..	..do .....	2	Positive .....	..do .....	2 dogs, 2 hogs, 2 hens, and 1 calf.

## BLACKLEG INVESTIGATIONS.

The preparation and distribution of blackleg vaccine has continued to be one of the most important pieces of routine work performed in the pathological laboratory and has followed along the same lines as during the previous year. The demand for this preventive remedy continues to increase, while the results obtained by the use of the vaccine are practically the same as for former years. The quantity of blackleg vaccine distributed among stock owners during the past year and the immunizing effect produced upon cattle by the vaccine distributed in the previous year are indicated in the appended tables:

*Doses of vaccine distributed during the fiscal year ended June 30, 1903.*

	Doses.
July 1 to December 31, 1902:	
July .....	65, 675
August .....	96, 385
September .....	180, 075
October .....	279, 170
November .....	233, 785
December .....	150, 820
January 1 to June 30, 1903:	
January .....	102, 820
February .....	105, 480
March .....	144, 210
April .....	184, 800
May .....	103, 690
June .....	82, 190
Total .....	1, 729, 100

*Results obtained from vaccine distributed during the fiscal year ended June 30, 1902.*

State or Territory.	Number of reports.	Number of cattle vaccinated.	Deaths same season previous to vaccination.		Died after vaccination.					
			Number.	Per cent.	Within 48 hours.	From 2 to 7 days after.	Within 1 year.	Number of cases due to mistakes.	Total number.	Percentage of deaths.
Arizona.....	20	1,661	84	5.05	4	2	4	10	0.60	
Arkansas.....	5	698	35	5.01	.....	.....	1	1	.14	
California.....	132	25,083	906	3.61	5	70	145	7	227	.90
Colorado.....	549	76,846	1,532	1.99	14	52	284	17	367	.47
Idaho.....	25	2,383	188	7.88	1	6	11	.....	18	.75
Indian Territory.....	109	20,254	690	3.4	6	21	45	.....	72	.35
Iowa.....	131	8,215	325	3.95	8	11	25	2	46	.55
Kansas.....	999	86,020	1,881	2.18	32	98	372	.....	502	.58
Kentucky.....	20	1,330	67	5.04	.....	1	1	.....	2	.15
Minnesota.....	46	5,044	105	2.08	.....	5	27	.....	32	.63
Missouri.....	352	17,344	522	3	6	32	90	.....	128	.73
Montana.....	227	26,497	560	2.11	7	13	112	23	155	.5
Nebraska.....	1,644	128,009	3,338	2.6	57	101	705	2	865	.67
New Mexico.....	26	5,716	224	3.91	2	4	22	18	46	.80
North Dakota.....	367	44,210	972	2.19	15	14	196	.....	225	.56
Oklahoma.....	154	22,057	692	3.13	5	22	66	15	108	.48
Oregon.....	25	2,762	105	5.8	1	4	8	.....	13	.47
South Dakota.....	480	42,639	1,409	3.3	28	19	81	6	134	.31
Tennessee.....	30	1,558	68	4.36	2	2	5	.....	9	.57
Texas.....	866	198,415	5,063	2.55	80	213	927	51	1,271	.64
Utah.....	14	1,813	60	3.3	2	.....	2	.....	4	.22
Virginia.....	185	7,281	257	3.52	4	17	48	.....	69	.94
Washington.....	40	1,855	82	4.42	1	1	14	.....	16	.86
West Virginia.....	64	2,107	82	3.89	1	.....	6	.....	7	.33
Wyoming.....	267	40,960	1,226	2.99	13	59	137	9	218	.53
Other States.....	89	5,120	403	7.87	7	2	12	.....	21	.41
Total.....	6,866	775,877	20,876	2.69	301	769	3,346	150	4,566	.58

It will be observed from the above table that 301 animals died within forty-eight hours of the time when they were vaccinated. It is probable that these cattle were infected with blackleg at the time of the injection, and, as the vaccine is a preventive, not a curative agent, this number should be deducted from the total number of deaths following vaccination. Mistakes have been made by stock owners in vaccinating their cattle, and should be eliminated in determining the immunizing value of the vaccine; but it is interesting to note the very small number made in comparison with the large number of cattle vaccinated. After deducting the number of cattle that died within forty-eight hours and those deaths that were admitted to be due to mistakes, the number of cases that died after vaccination is reduced to 4,115, or 0.53 per cent.

#### GLANDERS.

The preparation of mallein by the biochemic division has been continued, and during the year 7,331 doses have been shipped to the various States and Territories as follows:

	Doses.		Doses.
California.....	204	North Dakota.....	210
Colorado.....	36	Ohio.....	6
Delaware.....	36	Oklahoma.....	30
District of Columbia (War Department).....	3,000	Philippine Islands.....	20
Illinois.....	976	Porto Rico.....	160
Iowa.....	124	Rhode Island.....	3
Kansas.....	16	South Dakota.....	43
Massachusetts.....	6	Utah.....	6
Michigan.....	12	Vermont.....	165
Minnesota.....	1,206	Washington.....	52
Mississippi.....	30	Wisconsin.....	108
Missouri.....	6	Wyoming.....	6
Montana.....	864		
North Carolina.....	12	Total.....	7,331



## HOG CHOLERA AND SWINE PLAGUE.

The investigations concerning these two diseases have been continued. Some new and practical points of value have been determined, and efforts are being made to prepare a suitable vaccine for these diseases. The endeavors to secure a practicable antitoxin are also being continued, and work along other lines is being pushed as rapidly as is possible.

## MYCOTIC ENTERITIS.

During the past autumn numerous reports from various sections of the country reached the Bureau of a fatal disease among cattle, showing uniform symptoms. An investigation in response to an urgent request from central Virginia showed the trouble to be mycotic enteritis, due to eating moldy corn fodder, and a change of food with appropriate treatment checked the affection. This moldy condition of the food last fall seemed to be quite prevalent, and could be held responsible for the disease in question in a number of instances.

## LEUCO-ENCEPHALITIS IN HORSES.

Numerous letters were received from South Carolina and Georgia last winter urging an early investigation of a fatal malady of horses in that section. Five brains were received from typical cases of this disease, and a microscopic examination in the pathological division revealed those lesions that occur in epizootic leuco-encephalitis.

## CALF DIPHTHERIA.

An infectious pseudo-membranous inflammation of the tongue and lips of young cattle has occurred in epizootic form in many places in the West. While easily amenable to treatment, it has when neglected proved rapidly fatal, and has thus been the cause of considerable loss where not quickly recognized or where its nature was not fully understood. Investigations were made in the laboratory of the pathological division of portions of necrosed tissue sent in from the field. Microscopically they presented the pathological alterations so characteristic of calf diphtheria, namely, coagulation necrosis, the line of demarcation between healthy and diseased tissues being filled with bundles of long, undulating, beaded filaments, the *Bacillus necrophorus*.

## ULCERATIVE STOMATITIS IN HOGS.

More or less allied to this disease is ulcerative stomatitis in hogs, known among stockmen by the name of "sore mouth." This contagious malady appears frequently among sucking pigs, and is quite fatal. Investigations looking to the cause of this disease and also to the question of its relationship or identity with calf diphtheria are now in progress.

## FOOT ROT IN SHEEP.

This disease, known to the sheep owners of the United States since the earliest importations of improved breeds, and which still exists with greater or less severity among many flocks of the country, was so troublesome in the Middle Atlantic States during the year that further study of its cause was considered advisable.

From the interdigital pustules of some affected animals owned in Maryland, culture media were inoculated and an attempt made by the pathological division to isolate the specific organism to which foot rot may be due. The outbreak of foot-and-mouth disease in the New England States interrupted this work, and it is still unfinished, but enough has been done to prove that the organism which causes foot rot in sheep can be cultivated artificially for several generations without losing its virulent properties. Material obtained in September was at once sown in bouillon and the resulting mixed cultures were transplanted at intervals until early in November, at which time the third generation had been reached. These cultures would produce foot rot in healthy animals, the lesions appearing on the eighth and tenth day after the application of the culture to the slightly irritated skin in the cleft of the foot.

First, a moist condition of the surface of the skin was noticed, followed by the appearance of various inflamed spots, which rapidly spread and coalesced. Within twenty-four hours of the appearance of the reddened spots, the characteristic burrowing propensities of the disease were in full evidence, and the hoofs were soon undermined.

It was only by the use of mixed cultures that the lesions could be produced, and the isolation of the one specific cause remains for future accomplishment.

#### DIPPING CATTLE FOR TICKS.

The question concerning an effective tick dip for cattle has received further consideration at the experiment station of the Bureau, and very encouraging results have been obtained from the use of one substance. Three experiments have been made to test the value of natural mineral oil from Texas as a tick dip. The fact that the tick family is generally supposed to be very susceptible to the action of sulphur, and that the oil from the Texas wells was reported to be saturated with sulphur, led to the use of this oil.

The total number of animals dipped was necessarily small—12 to 14 young cattle. In every instance all the ticks were killed and the skins of the animals only very slightly and not at all seriously affected. The results obtained are such that a more extensive test of the oil should be made than is possible at the station. In station tests ticks raised in flasks were used, and the weather during the tests was not as warm as it commonly is during the summer months in the permanently infected tick territory. Ticks which have been grown under more natural conditions than the Bureau methods of raising them may be more resistant to the oil, and in a warmer climate the effects of the oil on the skins of the cattle may be more serious. These points should be tested by one or two large dipping experiments in the South, and until such experiments have been made and have confirmed the station results, the oil can not be recommended for general use.

#### COOPERATION WITH NATIONAL ZOOLOGICAL PARK.

Zoological gardens are becoming a feature in all large cities, and many even smaller communities have their collections of wild animals. Therefore, all matters concerning the diseases of these animals in captivity are of general interest and of economic importance.

A new phase of work this year has been the cooperation of the

pathological laboratory with the National Zoological Park. This has meant the autopsy of all fatal cases, the investigation of the causes of death among the animals, and the advising of preventive measures in certain cases. While no autopsy has been without its instructive features, some have been of peculiar pathological interest.

Most of the causes of death in the larger animals proved to be the result of gastro-intestinal disorders due no doubt to the enforced unnatural conditions in which they were necessarily kept, especially those relating to diet and confinement. The animals succumbing to these troubles were 5 buffalo, 3 bear, 3 lynx, and 1 monkey. The diseases due to infection varied widely, and from the histories obtained several of the animals at least were already affected when acquired by the park authorities. Thus, tuberculosis caused the death of 1 peccary, 1 agouti, and 1 monkey, while aspergillosis produced the death of a flamingo. Rabies also caused a serious loss. Attention was first directed to a den of foxes, the animals in which suddenly developed marked fighting propensities. Only one case was used for diagnostic purposes and, as soon as the trouble was recognized, the remaining foxes in this den were killed. Later on 3 wolves were affected with rabies, and a striking circumstance was the capture of a large stray dog in the park likewise affected. This occurred after the outbreak among the wolves and foxes, but it shows a probable source from which these confined animals may have become affected.

The following deaths were due to pneumonia: One caribou, 1 baboon, 1 kangaroo, 1 antelope, and 1 monkey. An agouti died of carcinoma-tosis, a llama succumbed as a result of diaphragmatic hernia, while parasitism (*Strongylus contortus*) was the only apparent cause of death in a Rocky Mountain sheep. Five necropsies have been held on snakes, which have resulted in incriminating two different diseases as causes of death. Three of them died as a result of abscess formation due to the entrance of a bacillus which has been isolated but not yet identified. The blood of 2 of the above contained large numbers of the reptilian protozoan of Danilewsky, but probably not in sufficient quantity to produce death.

The other two deaths were caused by a hemorrhagic septicemia associated with intense edema due to the presence of *Bacillus hydrophilus fuscus* Sanarelli. This organism produces a highly virulent septicemia among frogs and other cold-blooded animals, as well as among the smaller domestic animals. Feeding experiments conducted in this laboratory as well as elsewhere gave negative results. The mass of evidence emphasizes the entrance of the germ through lesions upon the external surface; hence the fact that *B. hydrophilus* is a water organism makes the recognition of its presence in any animal in captivity of interest as involving the contamination of certain waters, and being a possibility to be thought of in cases of rapid death among the smaller animals.

#### POULTRY-FEEDING EXPERIMENTS.

In order to obtain in a scientific manner some practical data for use in poultry feeding, a series of experiments has been conducted in the biochemic division in which an effort has been made to determine the comparative value of corn, wheat, and oats as poultry foods. The results obtained indicate that the crude proteid and nitrogen-free



extract of corn are more easily assimilable than those of oats. The crude fat of corn also seems to be more assimilable for chickens than that of wheat or oats. The use of corn alone has given more satisfactory results than either wheat or oats. This appears to be due chiefly to the fact that it is more palatable, and for this reason there is a somewhat greater consumption of the nutritive material. Corn can be fed at a much lower cost than wheat or oats. The details of these experiments, together with data for the establishment of practical, fixed rations, are given in a bulletin which has just been completed.

#### QUARANTINES AT PORTS OF ENTRY.

The miscellaneous division (which will become the quarantine division on July 1), under the immediate supervision of Dr. R. W. Hickman, has charge of the work connected with the quarantines at the several ports of entry, as well as the records of tuberculin tests in England, referred to elsewhere.

#### QUARANTINE STATION FOR THE PORT OF NEW YORK.

New York, being the chief seaboard port, is most frequently chosen by importing breeders as the port of entry for animals requiring inspection and quarantine. The work at the new animal quarantine station for this port, located at Athenia, N. J., has been progressing favorably during the year, and much has been done in the way of adding to its completeness as a quarantine station as well as in enhancing its beauty and attractiveness. Situated as it is in the foothills of the Orange Mountains, 12 miles in a direct line from New York City, the grading of the grounds and avenues, the road building, the turfing of banks, the planting of trees and shrubs, together with the building of several new permanent stables of the same attractive design and substantial construction as those previously erected to replace the temporary buildings erected last year, materially contribute toward making this place what was intended in its inception, namely, the model animal quarantine station of America, and hence of the world. One of the features contributing to the picturesqueness of this section of country, and, indeed, to nearly the whole of northern New Jersey, has rendered the work of grading a portion of this tract rather slow and tedious. At near the center of the irregular oblong comprised in the 43 acres therein contained, running through its transverse diameter, there is a considerable ridge of brownstone covered with timber. In the face of this ridge quarries had been opened and worked at intervals extending back through many years, as shown by the growth of trees in some of the old holes partly filled with débris from the quarries and dirt that had washed into them. Thus, work that has been done here should be mentioned among the improvements, otherwise the changes wrought by converting this rough, rocky waste into a wooded slope of grazing ground could only be appreciated by those familiar with the conditions which existed when the Government purchased the land. At the top of this slope among the trees a new stone building has been erected to accommodate the pumping and water-supply apparatus and electric plant for the station and grounds; and toward the opposite side of the tract, in a wooded vale below, a large building 160 feet in length has been erected and especially fitted for swine. In addition to this, the

accommodations for animals to be quarantined now consist of permanent and temporary buildings as follows: Thirteen brick stables, with a cattle capacity of 317, and eight frame stables, with a cattle capacity of 283, making a total cattle capacity of 600. The Department has expended this year for additional buildings and improvements at Athenia \$52,436.75, making the total cost thus far for the land (comprising 43 acres), buildings, and improvements about \$113,436. Congress has appropriated \$4,000 for the purchase of additional land, negotiations having been successfully conducted by Col. S. R. Burch, chief clerk of the Bureau, for two pieces containing about 9 acres, which separate the back or northeast corner of the station from the public road bounding its easterly side. This will prove a valuable addition, and make a total of about 52 acres in the station tract. The above appropriation becomes available July 1, 1903.

#### QUARANTINE STATION FOR THE PORT OF BOSTON.

The port of Boston was closed by order of the Secretary of Agriculture in November because of the occurrence of an outbreak of the contagious disease known as foot-and-mouth disease among animals in the States of Connecticut, Rhode Island, Massachusetts, and Vermont, in accordance with which Bureau of Animal Industry Orders Nos. 99 and 100 were issued under date of November 27, 1902, prohibiting the exportation from the port of Boston of cattle, sheep, or other ruminants or swine, and the movement of any of the above animals from or across the territory of any one of the above-named States. As a consequence, the entry of animals requiring quarantine at the port of Boston was limited to the first third of the fiscal year, and were as indicated in the succeeding table. Improvements at this station, located at Littleton, Mass., for the year consisted in necessary repairs to buildings, fences, and water-supply apparatus. For these \$64.24 was expended.

#### QUARANTINE STATION FOR THE PORT OF BALTIMORE.

The land for this station (located at Halethorp, Md.), as in the case of that for the port of Boston, is leased by the Department, and the expenses, apart from those incidental to the care of the property and animals quarantined there, have been likewise for necessary repairs, for which there has been expended \$387.04. It is very desirable that a piece of land be purchased for a quarantine station for this port located on Chesapeake Bay, in order that import animals may be unloaded directly from steamers by means of barges without the necessity of their reshipment by rail to the quarantine station. Such a change in the present arrangements would probably permit of the safe admission of importations of cattle, sheep, and other ruminants and swine from portions of the world now excluded, and which breeders of the various kinds originating in such countries are exceedingly desirous to import. The last session of Congress appropriated \$10,000 for the purchase of such a piece of land, which becomes available July 1, 1903, and steps will be promptly taken with a view to securing a suitable tract for this purpose.

#### ANIMALS QUARANTINED.

The following animals have all been subjected to inspection and quarantine, the length of the quarantine period imposed being fixed in

accordance with the requirements of the Department regulations for the class or subdivision of the class to which they belonged:

*Animals inspected and quarantined.*

Station.	Cattle.	Sheep.	Hogs.
Littleton, Mass.	39	6	8
Athenia, N. J.	549	577	95
Halsethorp, Md.	116		
Detroit, Mich.	3	1	
Sault Ste. Marie, Mich.	4		
Ogdensburg, N. Y.	6		
Buffalo, N. Y.	1		1
Niagara Falls, N. Y.	1		
Massena, N. Y.	9		
Cape Vincent, N. Y.	4		
Newport, Vt.	23	16	2
Richford, Vt.		5	
Beecher Falls, Vt.	60		1
Island Pond, Vt.	1	1	
St. Albans, Vt.	1	3	
Houlton, Me.	1		
Fort Fairfield, Me.	47	24	1
Eastport, Me.	1	3	5
Lowelltown, Me.		1	
Vanceboro, Me.	10	17	2
Total	875	654	115

There were also imported through the port of New York and quarantined under the supervision of the superintendent of the Athenia, N. J., quarantine station, 39 deer, 12 camels, 1 yak, 1 ibex, 2 wart hogs, 1 tapir, 7 antelopes, 2 moufflons, 4 llamas, 1 water buck, 2 zebus, 2 gazelles, 2 zebras, 1 Red River hog, 14 goats, 1 giraffe, 3 wild boars, 1 freak cow, 1 caribou, 1 reindeer, 1 anoa, and 11 miscellaneous ruminant show animals. In addition, 65 show animals were entered and inspected at the port of New York, belonging to Messrs. Barnum & Bailey, which were quarantined at their winter quarters at Bridgeport, Conn. There were imported through the port of Boston, Mass., and quarantined under the supervision of the superintendent of the quarantine station at Littleton, Mass., 2 deer, 1 antelope, and 1 goat; through the port of Ogdensburg, N. Y., 1 goat; through the port of Island Pond, Vt., 1 goat; and through the port of San Francisco, Cal., 4 guanacos and 2 alpacas. This makes a total of 1,831 imported animals that were quarantined.

The imports of animals from Canada not subject to quarantine at quarantine stations, but admitted upon inspection through the various stations along the Canadian border, were 8,697 cattle, 163,427 sheep, 3,751 horses, 25,115 swine, 11 moose, 1 deer, 14 asses, 3 mules, 5 goats, 3 camels, and 4 dogs—a total of 201,031.

ZOOLOGICAL WORK.

Owing to changes in the personnel of the division of zoology, the work there has been considerably interrupted. The chief of the division was transferred to the United States Public Health and Marine-Hospital Service in August, but has since been appointed consulting zoologist in charge, thus having general supervision of the work. The assistant chief was transferred in November to the field force of this Bureau. It was not until June that these two vacancies were filled, and on this account scientific investigations were interrupted,



while the regular routine work of correspondence, determination of specimens, cataloguing of literature, etc., was continued.

The division of zoology, United States Public Health and Marine-Hospital Service, has been quartered in the zoological laboratory of this Bureau during the fiscal year just ended, so that the two divisions were practically conducted as one, the scientific work being done by the marine-hospital men.

#### HOOKWORM DISEASE IN UNITED STATES.

The most important piece of work undertaken was the demonstration of the frequency of hookworm disease (uncinariasis) in man in the United States, an investigation which had been started while the chief of the division of zoology, Dr. Stiles, was still in this Bureau, and which he completed after his transfer. The fact that a new species of parasite (*Uncinaria americana*), distinct from the Old World form (*Agchylostoma duodenale*), infests man in this country was first recognized by the Bureau of Animal Industry, and forms the basis of all the recent work upon the disease conducted in this country. It has now been shown that this disease is very prevalent in certain parts of the United States, especially among the farming classes of the sand districts of the Southern Atlantic States.

#### MEAT INSPECTION.

The inspection of cattle, sheep, calves, and hogs and their products was in operation at 155 abattoirs and packing houses in 49 cities. During the year inspection was started at 8 abattoirs, 3 of which are in 2 cities not before represented. Inspection had been withdrawn from, or business had been suspended at, 7 abattoirs before the end of the preceding year, thus lessening the number of cities by 2. There was a net increase of 1 abattoir over the previous year. Horses were inspected at 1 other abattoir.

The number of establishments and cities where meat inspection has been in operation since the work was begun is shown in the following table:

*Establishments and cities where meat inspection was conducted, 1891 to 1903.*

Fiscal year.	Number of establishments.	Number of cities.	Fiscal year.	Number of establishments.	Number of cities.
1891.....	9	6	1898.....	135	35
1892.....	28	12	1899.....	139	42
1893.....	37	16	1900.....	149	46
1894.....	46	17	1901.....	157	52
1895.....	55	19	1902.....	155	50
1896.....	102	26	1903.....	156	50
1897.....	128	33			

The table on the next page shows the extent of the inspection of animals before they are slaughtered. The number of animals rejected on this inspection is also given. These animals are tagged and are held for further disposition; some are slaughtered immediately and are condemned or not, according to their condition. Pregnant animals may be released to go to the country when there is no danger of spreading the contagion of any disease.

*Ante-mortem inspections for the fiscal year 1903.*

Kind of animal.	For official abattoirs in cities where inspections were made.	For abattoirs in other cities and miscellaneous buyers.	Total inspections.	Rejected, subject to result of post-mortem inspection.	
				At abattoirs.	In stock yards.
Cattle .....	6,213,783	5,774,977	11,988,760	771	40,489
Sheep .....	8,401,300	6,252,949	14,654,249	1,873	16,014
Calves .....	609,428	431,710	1,041,138	646	4,796
Hogs .....	21,707,381	9,838,841	31,546,222	3,037	58,260
Horses .....	344	.....	344	.....	.....
Total .....	36,932,236	22,298,477	59,230,713	6,327	119,559

The number of hogs inspected ante-mortem for official abattoirs fell from 25,096,684 to 21,707,381. The number of cattle rose from 5,733,698 to 6,213,783. The number of sheep increased considerably, 8,401,300 being inspected, against 7,497,738 last year.

The inspection of animals at time of slaughter, with the number of carcasses and parts of carcasses condemned and tanked, is shown in the next table. The number of condemnations for trichinosis is given under the head of "Microscopic inspection of pork."

*Post-mortem inspections for the fiscal year 1903.*

Kind of animal.	Number of inspections.			Carcasses condemned.			Parts of carcasses condemned.
	For official abattoirs.	On animals rejected in stock yards.	Total.	For official abattoirs.	Animals rejected in stock yards.	Total.	
Cattle .....	6,134,410	31,480	6,165,890	11,619	2,986	14,605	3,090
Sheep .....	8,585,960	12,215	8,598,175	10,570	4,663	15,233	106
Calves .....	668,855	1,318	670,173	1,257	372	1,629	76
Hogs .....	21,798,788	33,309	21,827,047	41,841	5,153	46,994	61,208
Horses .....	344	.....	344	11	.....	11	.....
Total .....	37,183,307	78,322	37,261,629	65,298	13,174	78,472	64,480

In addition to the carcasses condemned as above, and to those condemned for trichinosis, the number tanked for other reasons is given in the table below. These were the carcasses of animals that had died in the cars or pens at abattoirs, or that died after inspection in the stock yards, or that were killed by city inspectors.

Manner of death.	Cattle.	Sheep.	Calves.	Hogs.	Horses.	Total.
Died in yards .....	450	899	92	1,521	.....	2,962
Killed in yards .....	244	45	5	19,726	.....	20,020
Died at abattoirs .....	550	1,928	246	10,020	.....	12,744
Total .....	1,244	2,872	343	31,267	.....	35,726

The total number of carcasses and parts condemned and tanked, with the causes of condemnation, and including the animals found dead and those killed by city inspectors, is shown in the following:

*Causes of condemnation of carcasses and parts of carcasses, fiscal year 1903.*

Cause of condemnation.	Cattle.		Sheep.		Calves.		Hogs.		Horses.
	Car-casses.	Parts.	Car-casses.	Parts.	Car-casses.	Parts.	Car-casses.	Parts.	Car-casses.
Actinomycesis .....	834	837	.....	.....	5	1	32	44	.....
Tuberculosis .....	8,598	250	10	.....	16	.....	20,299	52,006	.....
Caseous lymphadenitis .....	.....	.....	2,567	2	.....	.....	.....	.....	.....
Cholera and swine plague .....	.....	.....	.....	.....	.....	.....	19,256	.....	.....
Texas fever .....	258	.....	.....	.....	40	.....	.....	.....	.....
Echinococcus .....	.....	.....	5	2	.....	.....	12	164	.....
Measles .....	.....	.....	.....	.....	.....	.....	12	.....	.....
Scabies .....	.....	.....	1,267	.....	.....	.....	45	.....	.....
Eczema .....	.....	.....	.....	.....	.....	.....	7	.....	.....
Erysipelas .....	.....	.....	.....	.....	.....	.....	14	.....	.....
Cancer .....	101	.....	3	.....	1	.....	7	.....	.....
Tumor .....	5	5	1	.....	.....	.....	347	706	.....
Abscess .....	108	538	107	13	9	5	625	899	.....
Pneumonia .....	162	.....	368	.....	17	.....	746	.....	1
Pleurisy .....	3	.....	20	7	2	.....	48	14	4
Carditis .....	.....	.....	1	.....	.....	.....	.....	.....	.....
Enteritis .....	31	.....	91	.....	11	.....	240	.....	.....
Peritonitis .....	189	.....	78	.....	38	.....	439	.....	.....
Metritis .....	22	.....	26	.....	2	.....	130	.....	1
Nephritis .....	2	.....	11	.....	3	.....	26	.....	.....
Uremia .....	4	.....	12	.....	1	.....	15	.....	.....
Mammitis .....	.....	.....	1	.....	.....	.....	2	85	.....
Septicemia .....	253	.....	209	.....	54	.....	486	.....	2
Pyemia .....	293	.....	175	.....	25	.....	1,696	.....	1
Gangrene .....	33	.....	10	.....	10	4	16	.....	.....
Anemia, emaciation, marasmus .....	1,981	.....	8,417	.....	78	.....	412	.....	2
Ascites and anasarca .....	14	.....	32	.....	1	.....	42	.....	.....
Jaundice .....	5	.....	407	.....	7	.....	620	.....	.....
Extreme temperature, various causes .....	2	.....	57	.....	12	.....	1,069	.....	.....
Pregnancy .....	47	.....	40	.....	.....	.....	77	.....	.....
Recent parturition .....	48	.....	9	.....	.....	.....	36	.....	.....
Hernia .....	4	.....	3	.....	1	.....	3	.....	.....
Downers, bruised, injured, etc. ....	1,627	1,460	1,240	82	229	66	235	7,290	.....
Dead from various causes .....	1,000	.....	2,827	.....	338	.....	11,541	.....	.....
Too young .....	.....	.....	3	.....	1,065	.....	.....	.....	.....
Killed by city inspectors .....	244	.....	45	.....	5	.....	19,726	.....	.....
Asphyxia .....	31	.....	.....	.....	.....	.....	.....	.....	.....
Melanosis .....	.....	.....	.....	.....	1	.....	.....	.....	.....
Arthritis .....	.....	.....	.....	.....	1	.....	.....	.....	.....
Flukes .....	.....	.....	1	.....	.....	.....	.....	.....	.....
Edema .....	.....	.....	1	.....	.....	.....	.....	.....	.....
Big head .....	.....	.....	1	.....	.....	.....	.....	.....	.....
Distoma .....	.....	.....	28	.....	.....	.....	.....	.....	.....
Pulmonary apoplexy .....	.....	.....	6	.....	.....	.....	.....	.....	.....
<i>Cysticercus tenuicollis</i> .....	.....	.....	1	.....	.....	.....	.....	.....	.....
Bladder worm .....	.....	.....	1	.....	.....	.....	.....	.....	.....
Lardaceous degeneration .....	.....	.....	2	.....	.....	.....	.....	.....	.....
Anthrax .....	.....	.....	22	.....	.....	.....	.....	.....	.....
Total .....	15,849	3,090	18,105	106	1,972	76	78,261	61,208	11

For the purpose of comparison, the number of animals inspected at time of slaughter for abattoirs having inspection, for the fiscal years 1891 to 1903, is given on the next page.



*Number of animals inspected at slaughter for abattoirs having inspection, fiscal years 1891 to 1903.*

Fiscal year.	Cattle.	Calves.	Sheep.	Hogs.	Horses.	Total.
1891	83,889					83,889
1892	3,167,009	59,089	583,361			3,809,459
1893	3,922,079	92,947	870,512			4,885,538
1894	3,861,594	96,331	1,020,764	7,648,146		12,626,835
1895	3,704,042	116,093	1,428,601	13,616,539		18,865,275
1896	3,985,484	256,905	4,629,796	14,250,191		23,122,376
1897	4,242,216	273,124	5,209,161	16,808,771		26,533,272
1898	4,418,738	244,330	5,496,904	20,893,199		31,053,171
1899	4,382,020	246,184	5,603,096	23,836,943	3,332	34,071,575
1900	4,841,166	315,693	6,119,886	23,336,884	5,559	34,619,188
1901	5,219,149	413,830	6,639,212	24,642,753	1,992	36,916,936
1902	5,559,969	555,836	7,434,878	25,277,107	1,649	38,829,439
1903	6,134,410	668,855	8,585,960	21,793,738	344	37,183,307

The meat inspection tag or label was placed upon 21,124,318 quarters, 362,689 pieces, and 186 sacks of beef; 8,571,643 carcasses of sheep; 667,259 carcasses of calves, 880,945 carcasses of hogs, and 696,279 sacks of pork.

The meat inspection stamp was affixed to packages of meat products that had received the ordinary inspection, as follows: 7,520,854 of beef, 59,314 of mutton, 14,601,202 of pork, and 70 of horseflesh—a total of 22,181,440.

The number of cars sealed, containing inspected meat products for shipment to official abattoirs and other places was 67,046.

The number of certificates of ordinary inspection issued for meat products for export, exclusive of horseflesh, was 30,152. Of beef, there were 1,388,633 quarters, 20,422 pieces, 401 bags, and 1,352,291 packages, with a weight of 371,920,737 pounds; of mutton, there were 35,394 carcasses and 22,527 packages, weighing 2,729,013 pounds; of pork there were 24,380 carcasses and 506,311 packages, weighing 133,122,610 pounds.

The decrease in the certified exports of beef and pork, noted in the last report, continued, the figures showing a decline from the last year of 45,070,025 pounds of beef, and 55,237,401 pounds of pork. The exports of mutton were nearly two and a half times as much as last year, when there were 1,145,248 pounds certified.

There was one shipment of horseflesh, 70 packages weighing 28,000 pounds.

The following table shows for several years the amounts of beef, pork, and mutton for which certificates were issued, not including microscopically examined pork:

*Quantities of beef, mutton, and pork for export upon which certificates of ordinary inspection were issued, 1898 to 1903.*

Fiscal year.	Beef.	Mutton.	Pork.
	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>
1898	339,650,091	324,996	244,956,482
1899	360,843,856	525,705	278,696,435
1900	433,138,233	680,897	272,050,663
1901	452,830,373	894,648	231,144,988
1902	416,990,762	1,145,248	188,360,011
1903	371,920,737	2,729,013	133,122,610

The cost of the work of the ordinary meat inspection for the year was \$711,546.18.

## MICROSCOPIC INSPECTION OF PORK.

The number of carcasses examined was 489,667, classified as follows: Class A (free of all appearances of trichinæ), 477,195, or 97.45 per cent; Class B (containing trichina-like bodies or disintegrating trichinæ), 7,394, or 1.51 per cent; Class C (containing living trichinæ), 5,078, or 1.04 per cent.

There were 5,136 trichinous carcasses disposed of during the year; these weighed 1,093,376 pounds, and about 41 per cent was tanked and the rest made into cooked meat.

The number of certificates issued for microscopically inspected pork products for export was 3,132; the number of packages stamped and exported was 62,779, weighing 19,108,341 pounds. The exports decreased 14,572,888 pounds.

The following shows the exports of pork to countries requiring a certificate of microscopic inspection, from 1892 to 1903:

	Pounds.		Pounds.
1892.....	22,025,698	1898.....	120,110,356
1893.....	8,059,758	1899.....	108,858,149
1894.....	18,845,119	1900.....	55,809,626
1895.....	39,355,230	1901.....	35,942,404
1896.....	21,497,321	1902.....	33,681,229
1897.....	42,570,572	1903.....	19,108,341

The cost of the microscopic inspection was \$78,179.63, being an average of 16 cents for each examination, and for each pound exported, 0.41 cent.

## INSPECTION OF VESSELS AND EXPORT ANIMALS.

The number of certificates of inspection issued for American cattle exported to Europe was 960. The number of clearances of vessels carrying live stock was 634. The number of sheep exported to Europe decreased from 211,224 in 1902 to 111,448 this year. The exports of horses fell off very considerably, also, being 3,910 this year, as against 10,967 in 1902. All of the animals shown in the following table were exported to Great Britain, except 1,752 cattle, 832 sheep, and 88 horses to Belgium, and 191 horses to Germany.

*Number of inspections, etc., of American and Canadian animals, fiscal year 1903.*

Kind of animal.	American.				Canadian.		
	Inspections.	Rejected.	Tagged.	Exported.	Inspected.	Rejected.	Exported.
Cattle .....	530,874	1,693	301,118	a 288,365	43,269	36	43,233
Sheep .....	195,463	67	.....	b 111,448	47,780	51	47,729
Horses.....	5,172	1	3,996	3,910	120	.....	120

a 35,437 via Canada.

b 1,738 via Canada.

There were also inspected for export to other countries, 1,797 cattle, 1,847 sheep, 1 horse and 12 mules; they were distributed as follows: 1,645 cattle, 1,702 sheep, and 1 horse to Bermuda; 145 sheep to Barbados; 140 cattle to Brazil; 12 cattle and 12 mules to Jamaica.

The number of American and Canadian animals landed alive at the foreign animals wharves in London, Liverpool, and Glasgow, and inspected by inspectors of this Bureau stationed at these parts, together with the number and percentages lost in transit, is shown in the table following.

*Number of animals inspected at time of landing in London, Liverpool, and Glasgow, and lost in transit, fiscal year 1903.*

From—	Cattle.			Sheep.			Horses.		
	Landed.	Lost.		Landed.	Lost.		Landed.	Lost.	
	No.	No.	Per ct.	No.	No.	Per ct.	No.	No.	Per ct.
United States.....	245,461	249	0.10	104,180	947	0.90	3,423	30	0.87
Canada.....	48,406	81	.19	48,082	705	1.44	144	2	1.37
Total.....	288,867	330	.11	152,262	1,652	1.07	3,567	32	.89

#### INSPECTION OF IMPORTED ANIMALS.

The inspection of animals imported from Mexico is shown in the table following:

*Importation of Mexican animals, fiscal year 1903.*

Port of entry.	Cattle.	Sheep.	Hogs.	Goats.	Horses.	Mules.	Burros.	Asses.
Eagle Pass, Tex.....	2,464	.....	.....	568	8	.....	.....	.....
El Paso, Tex.....	32,248	.....	65	.....	12	37	.....	.....
Nogales, Ariz.....	14,698	125	40	447	.....	.....	.....	1
San Diego, Cal.....	2,370	3,994	92	779	59	9	1	2
Total.....	52,780	4,119	197	1,794	79	46	1	3

There were also inspected animals imported from Mexico, in bond, as follows: At Nogales, 93 cattle in transit to Mexico; at El Paso, 1,036 horses, 7 mules, 14 asses, and 23,968 cattle, and at Eagle Pass 3,222 cattle, in transit to Canada.

Through ports on the seacoast animals not subject to quarantine were imported as follows:

From—	Horses.	Ponies.	Mules.	Donkeys.	Asses.
Great Britain.....	1,901	134	.....	1	12
Germany.....	247	.....	.....	.....	.....
Belgium.....	355	1	.....	.....	26
Italy.....	4	29	.....	4	.....
India.....	14	.....	.....	.....	.....
China.....	1	.....	.....	.....	.....
Haiti.....	.....	1	.....	.....	.....
Santo Domingo.....	1	.....	.....	.....	.....
Trinidad.....	1	1	1	.....	.....
Bermuda.....	17	2	.....	.....	.....
Cuba.....	3	.....	.....	1	.....
Chile.....	.....	1	.....	.....	.....
Mexico.....	5	.....	.....	.....	.....
Canada.....	53	.....	.....	.....	.....
Total.....	2,602	169	1	6	38

There were also imported 1 goat, 1 cow, 6 sheep, 5 zebras, 6 llamas, 2 elephants, 2 lions, 1 tiger, 1 bear, 1 leopard, 1 monkey, 11 dogs.



A statement of other animals imported will be found under the head of "Quarantines at ports of entry."

#### CONTROL OF CONTAGIOUS DISEASES.

##### SOUTHERN CATTLE INSPECTION.

The supervision of the movement of cattle from the district quarantined on account of splenic fever involved the proper yarding in the quarantine divisions of the various stock yards of 1,620,403 cattle during the quarantine season of 1902. It required 56,608 cars to transport these animals, and all the cars had to be placarded and the waybills and other papers had to state that the cattle were Southern cattle. The number of cars cleaned and disinfected was 66,116.

In Texas 389,525 cattle were inspected and identified as originating outside the quarantine district, and were permitted to be moved to Northern States for grazing.

##### SCABIES IN SHEEP.

The number of sheep inspected at stock yards, feeding stations, and on farms and ranges, amounted in the aggregate to 16,444,370. This number, however, includes sheep reinspected at various places, and therefore does not give the actual number of individual sheep.

The number of sheep dipped under the supervision of inspectors was 2,167,002; of these 394,636 were dipped twice.

#### THE WORK OF THE DAIRY DIVISION.

The chief distinction between the work of the dairy division during the fiscal year ending June 30, 1903, and that of preceding years, has been the additional duty assigned to it in connection with the administration of those parts of the act of Congress approved May 9, 1902, under which certain duties devolve upon the Secretary of Agriculture concerning the manufacture, interstate commerce, and export of renovated butter.

In preparation for this service, a code of regulations for the execution of the law stated, and required by its provisions, was formulated by a joint board composed of representatives of the two Executive Departments concerned, and approved by the Secretary of the Treasury and the Secretary of Agriculture. These regulations were published in the form of Bureau of Animal Industry Order No. 94, dated June 21, 1902, and republished, slightly amended, as Bureau of Animal Industry Order No. 98, dated November 1, 1902.

So far as they relate to the Department of Agriculture, these regulations are intended for the proper enforcement of the provisions and manifest purposes of section 5 of the said act; they contemplate the sanitary inspection of materials, factories, and processes necessary to insure a sound and wholesome product and methods of packing and marking the same which will preserve its commercial identity and make renovated butter known to all buyers as distinct from other kinds or grades of butter. The marks, labels, or brands required for this commodity are the same when the subject of interstate commerce as when exported from the United States.

Various questions have arisen regarding the interpretation and

application of these regulations, and for a time there were strenuous efforts made to have them modified. The Secretary of Agriculture, after hearing the various parties concerned and giving full consideration to the subject, decided that there was no sufficient cause for change. The regulations promulgated in November are still in force, and during the last few months there have been no remonstrances or complaints regarding them.

The work of inspecting renovated-butter factories and markets was at first assigned to the three inspectors of dairy exports already employed, and two additional inspectors temporarily appointed for the purpose. It was soon found necessary to double this force, and, through the instrumentality of the United States Civil Service Commission, a special examination was held in December and a corps of ten dairy inspectors appointed, who were regularly on duty during the latter part of the year. One of these is a temporary appointment. Four of these inspectors are not yet on duty during the whole of any one month, but the work is increasing and all will soon be needed for practically their entire time. They may continue, as now, to include in their duty such supervision as is necessary of dairy exports in general and the conduct of special dairy investigations.

These dairy inspectors constitute a body of men of rare experience in the production, testing, grading, and handling of dairy products of all kinds, the detection of dairy adulterations, imitations, and frauds, and the execution of dairy laws. It would be difficult to find, if needed, an equal number of men of like expert knowledge, skill, and tried judgment.

During the fiscal year 1902-1903, these inspectors, assisted to some extent by the chief and assistant chief of the dairy division, have repeatedly inspected 82 renovated-butter factories, and have visited 300 cities and towns in 45 States, Territories, and the District of Columbia for the purpose of ascertaining the extent to which renovated butter is distributed in domestic markets and the conditions under which this special commodity is sold at wholesale and retail.

Factories to the number of 82 have been licensed and bonded by the Treasury Department for the manufacture of renovated butter. They were located in 17 States and the District of Columbia. Of these factories, 28 have been in operation throughout the fiscal year, 23 commenced operations subsequent to July, 1902, and continued until the end of June, 1903, and 31 ceased manufacturing before the close of the year.

The total quantity of renovated butter made at licensed factories during the fiscal year 1902-1903 was 54,656,800 pounds. Of this amount, about 500,000 pounds remained in possession of the manufacturers, taxes unpaid, at the close of the year. A close estimate of the like manufacture for the fiscal year 1901-1902, being the next before the date when a tax was placed upon the product, and based largely upon factory records, shows the output to have been about 50,000,000 pounds, made at 55 factories.

For the purpose of closer comparison of the product of the two fiscal years mentioned, 10 factories have been selected, located in six States, from which accurate records of the output of both years have been obtained; all were in operation twelve months in each year. The totals are as follows: Ten factories produced in 1901-1902, 17,082,274 pounds; the same produced in 1902-1903, 18,609,718 pounds.

The business thus increased 9 per cent in volume. It is shown by this comparison, as well as by other facts of record, that the law in question has not been obstructive and has proved no hindrance to manufacturers who have cheerfully acquiesced in its provisions and energetically conducted their business.

During this first year of the operation of the law, officers of the Department have inspected 144 different lots of renovated butter about to be exported to foreign countries, comprising 23,820 packages and approximately 1,312,000 pounds.

The principal facts developed by the market inspections follow: The retail trade in renovated butter is comparatively small, and in many places is wholly suspended during the summer months, when creamery butter is comparatively cheap and when supplies are at the maximum of low-priced fresh dairy or country butter. In some places, notably in the Pacific and Mountain States, and some of the Southern States, renovated butter is still almost unknown, even by merchants. In large sections of the country, especially the New England and Middle States and the Central West, this kind of butter is nearly always to be found in market at least half the year, and competes directly with all classes of butter except the best creamery. Wholesale dealers and large jobbers and distributors handle it, as a rule, in the original packages as received from manufacturers, with all stamps, brands, and identifying marks intact. Some jobbers are known to disregard the purpose of the law and the cautions given in labels and regulations by removing renovated butter from the original packages, destroying all marks, and selling it without making known its special character and grade. This is believed to be an illegal practice, and a suit has been instituted in the United States court for the district of Connecticut to secure a judicial determination of the question. Twelve States have special laws regulating the sale of renovated butter, and in most of them these laws are well enforced and the commercial identity of the article is preserved and made known to the purchasing consumers. In a few States where the laws are not executed, and in others which have none, retail dealers in renovated butter may be divided into two classes, apparently about equal in number. The one class practices honesty in trade, selling renovated butter under its right name, with all identifying marks preserved; the other class endeavors to facilitate trade, or increase profits, by concealing the identity of the taxed article and disposing of it simply as "butter," or under false names and marks, at the highest possible price. Millions of pounds are thus unquestionably still retailed as creamery butter and at corresponding prices, as was very generally done prior to the enactment of this law.

The quality of renovated butter has been much improved. The difference between the average quality of the product during the past year and the same commodity a few years ago is very marked. This is due to improved machinery and processes, and also to the better average quality and condition of the packing stock or raw material used. The development of the business, with wider distribution and better organization and natural competition among manufacturers, have prevented the former accumulations of country butter at remote points, kept the stock comparatively well cleared up, and resulted in some improvement in packages, packing, and transportation to factories or to markets. The average character and condition of the material used in this manufacture is therefore decidedly better than



formerly. Occasionally, a lot of packing stock is found in such a condition of filth or putrefaction as to necessitate condemnation. In two instances material of this character has been manufactured before being seen, so the finished product had to be condemned as unfit for food. In such cases inspectors have required that material and product be disposed of as grease. But these instances are very exceptional. There is still opportunity for great improvement in materials, in the manner of handling the same, and in the finished product, but, as a rule, manufacturers are endeavoring to improve conditions at all points and are ambitious to win a reputation for producing an article of high quality.

Renovated butter reaches market in various grades as to quality, the same as other butters. There are products good, bad, and indifferent from different factories and sometimes from the same factory. Renovated butter generally ranks as the equal of creamery butter of "seconds" grade in quality and price, and sometimes it is as good as creamery "firsts." Recently, when creamery "extras" (highest grade) were selling in New York at 20 cents wholesale, the best grade of renovated commanded 18 cents. One case is known where 700 packages of creamery butter of "firsts" grade were sold by the makers for 16½ cents per pound, when the same manufacturers were readily selling their best renovated product at 17 cents. The best renovated goods compare favorably with the general run of best dairy or farm butter in the market, although the latter usually sells a shade higher. The position of renovated butter in the general market is becoming more and more fixed. The required markings serve as a guaranty of purity and to its standing. They are seldom objected to except by those who want to dispose of this article as another kind of butter and at a higher price.

It was the evident intent of the law to mark renovated butter so distinctly as to make its character or kind known all the way from the manufacturer to the consumer. But the law fails to fully accomplish this object. Having sufficiently provided for marking or branding the butter itself, its covers and packages, section 5 of the act of May 9, 1902, protects these Government marks only by indirection and reference to other statutes. By reason of this omission or imperfection, some merchants who obtain the article from manufacturers, properly packed and marked, empty the original packages, as already stated, destroy the identifying marks, and repack the commodity in various forms, marked "creamery butter," or otherwise falsely labeled, or not marked at all, and resell to dealers and consumers without informing these buyers that it is renovated butter. The purpose of the law is thus defeated. Section 5 should be amended so as to provide specific penalties for destroying or defacing any of the duly authorized marks upon renovated butter and its packages.

The predictions that the law referred to would be detrimental to the interests of makers of country butter of the poorer grades, which goes to make up the bulk of the "packing stock," reducing its price and the consequent income of farmers from this source, have not proved true. Since the law went into effect two attempts have been made to combine manufacturers of renovated butter, who are the chief buyers of packing-stock butter, and fix a low maximum price for the latter; but the efforts have failed through the competition of buyers who needed the material to keep their renovating factories in operation.

During part of the season of 1901, and still more during the earlier portion of 1902, a feverish condition of the market led to abnormally high prices being paid for packing-stock butter to be stored for manufacture later. The prices of these low grades of butter ranged very high for a time, although the farmers who first sold it received but a small part of this temporary advance. The whole movement was exceptional and entirely independent of the law of Congress and its effects. Since the operations of the law have become generally understood and its effects appreciated, the market for the new material has been comparatively steady and prices for packing stock have been relatively as high as two and three years ago, and higher than for several years just preceding the introduction of the renovating process.

In the administration of that portion of the law regarding renovated butter which is assigned to the Department of Agriculture during this first year after going into effect, many allowances have been made for errors and omissions in observing the regulations, due to the novelty of the subject, misunderstandings, and inadvertence, and even in cases of indifference and negligence. It is believed that, after one full year's experience in operating factories under the law, with repeated visits and explanations from inspectors, in addition to printed instructions and special correspondence, it is time more strictly to enforce the reasonable regulations and time to make the sanitary inspections more effective.

The dairy division has again assisted in procuring butter for the use of the United States Navy by perfecting specifications and supervising the execution of contracts. Dairy inspectors have examined and passed upon 700,000 pounds of butter included in naval contracts during the year, and the Navy Department has acknowledged the service rendered and its satisfactory results. A much less quantity of butter has been inspected for the Army, upon the application of purchasing officers for the Subsistence Department.

By the cooperation of this division a "National educational test of creamery butter" was conducted covering six months and embracing monthly samples of the product of about 500 creameries located in 19 different States. Incidentally, determinations were made of the moisture content of 730 packages of butter from 400 representative creameries in 18 States, with the gratifying result of showing that the average creamery butter of the country appears to contain less than 12 per cent of water.

A cooperative experiment in the cold-curing of cheese upon a commercial scale was carried on in conjunction with the agricultural experiment stations of Wisconsin and New York. The report of this work is now in press.

The work of the dairy division during the fiscal year 1903-1904 will embrace, in large measure, a continuation of that of previous years, and also include several material additions. The condition of the dairy industry of the United States will be studied in all its aspects, with a view to determining the most favorable opportunities and methods for progress and improvement and assisting in their accomplishment. The dairying of other countries will also be observed, productive conditions noted, the demands of consumption and of all foreign markets watched, and such action taken as is possible in the interest of extending foreign trade in the dairy products of this country. Relations will be maintained with State dairy officials with a view to cooperation

in the enforcement of law; also with the voluntary organizations of dairymen and the dairy schools in numerous States, in order to be informed of their proceedings and to cooperate so far as may be advisable.

The inspection of renovated-butter factories and markets will continue and be gradually extended and improved for the better administration of section 5 of the act of Congress of May 9, 1902.

This division will conduct investigations by itself or in cooperation with suitable agencies. An exhaustive study will be made of the conditions and limitations incident to the extension of the dairy industry in "the short-grass country" or "semiarid region" east of the Rocky Mountains. This will include careful consideration of the centrifugal cream separator for hand power or light power and its proper relations to the creamery system of making butter. A series of commercial tests will be conducted to determine the relations between different temperatures and other atmospheric conditions in storage and the maintenance of quality in butter stored for several months. It is also proposed to investigate the manufacture of condensed milk and the action which may be expedient to preserve and promote the reputation of this country for producing this article in a form suited to foreign markets.

In considering the future of the dairy division, it should be first remarked that, after eight years' existence, the work in hand and the opportunities for usefulness in extending present lines of effort and taking up new ones are much greater than can be accomplished by the original organization. The dairy industry is one of the most important and most extensive branches of American agriculture. Four-fifths of all the farms in the country keep cows for milk, seventeen million in number, and another million are reported "not on farms." The annual product of these eighteen million dairy cows has a value of about \$600,000,000. The opportunities for improvement are manifest at many points. If the average cost of maintaining a cow could be lessened by intelligent economy, or the average dairy product slightly increased in quantity by rational treatment, or the average quality of dairy products raised a little by improved methods of practice, the aggregate additional profit would be very great. For example, one-third of all the butter produced in the United States is made in creameries and two-thirds on farms. The former, by reason of higher average quality, has a value of at least 3 cents per pound greater than the latter. If one-half the butter now made on farms could be made in creameries or in any way to make it as good as average creamery butter, the increased income to this third (only) of our butter producers would amount to \$15,000,000 a year. Again, if the average municipal milk supply could be but slightly improved in quality and sanitary condition and the service correspondingly improved, the gain in the comfort and health of millions of people would be beyond measurement by dollars. Such improvements are entirely practicable and in large measure comparatively easy of accomplishment. In the accomplishment of them the dairy division strives to assist and sometimes to lead, doing those parts of the work which are impossible to individuals, or even associations of individuals.

#### THE ANGORA GOAT INDUSTRY.

The great interest which has become widespread in the Angora goat industry during the past three years has not abated in the least, and



this Bureau has done everything possible to assist the Angora goat raisers to place this industry upon a permanent basis. The correspondence concerning this feature of the work has been cared for in the editorial office, and the editor, Mr. George Fayette Thompson, visited the annual show at Kansas City in October and addressed the breeders along lines favorable to better animals and better mohair. There is a constant demand for the literature on this subject published by the Bureau, and there is every evidence that the industry is rapidly becoming established in all parts of the country.

The disease which has been given the name of "takosis," referred to in my last report, seems to have about run its course, and it is hoped that it will not reappear. In the meantime, purchasers are advised to select animals carefully in order not to introduce the disease into flocks where it has not already existed.

#### ANIMAL HUSBANDRY.

The expert in animal husbandry, Mr. George M. Rommel, has prepared an extensive bulletin on the hog industry in the United States, and it is now ready for the printer. He has also devoted considerable time to an investigation of alleged irregularities of a certain breeders' association, and his report on this matter has been placed in the hands of the Secretary. These investigations have shown the necessity of more careful supervision by this Department over the importation of animals for breeding purposes, and more careful scrutiny of the registers accepted as evidence of the pure breeding of animals admitted free of duty.



## REPORT OF THE CHIEF OF THE BUREAU OF PLANT INDUSTRY.

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U. S. DEPARTMENT OF AGRICULTURE,  
BUREAU OF PLANT INDUSTRY,  
*Washington, D. C., September 1, 1903.*

SIR: I have the honor to submit herewith a report giving an account of the work of the Bureau of Plant Industry for the fiscal year ended June 30, 1903, and an outline of the proposed investigations for the present fiscal year.

Respectfully,

B. T. GALLOWAY,  
*Chief of Bureau.*

Hon. JAMES WILSON, *Secretary.*

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### SUMMARY OF THE YEAR'S WORK.

During the year the Bureau of Plant Industry has devoted its energies to the end of bettering agricultural conditions in the United States. The more important results accomplished are set forth in the accompanying pages, and may be briefly summarized as follows:

The cooperative work with the State experiment stations has been enlarged, more than 40 stations now being in active cooperation with the Bureau on many varied lines. Studies have been made of successful farms and farming methods in certain typical regions, with a view to securing data which will be of value and which may be applied to other regions. There are thousands of highly successful farmers and fruit growers in the country whose methods, if known, could be adopted by others. The methods followed will be set forth by the Bureau under the plan of "Farm management." Demonstration work has been inaugurated in nearly all parts of the country to show the advantages of methods and crops recommended by the Department. This work has been followed in combating plant diseases, in the introduction of various crops, particularly in the South and West, in the planting of new cottons and other crops secured as a result of breeding and selection, and in the introduction of crops from foreign countries. Several demonstration farms have been established, the expense in such cases being borne for the most part by private citizens. Foreign explorations have been continued. Agents have visited Europe, parts of Asia, Africa, Mexico, and other countries for the purpose of securing new seeds and plants of promising value to the United States. Plans for an extensive exhibit at the St. Louis Exposition have been made and put into operation. Nature study work in the public schools has been encouraged by the distribution of seeds suitable for school gardens, by giving special instructions to normal school teachers,



particularly in Washington, D. C., and by the encouragement of home gardens through publications and in other ways. Highly successful results were obtained in the spraying of orchard fruits, it being shown that fruits so sprayed were more resistant to "scald" while in cold storage. Successful results were secured in the treatment of peach and plum diseases by spraying. The fact that the "little peach" disease, like "yellows," is transmissible by budding was demonstrated, and extensive experiments in its eradication by the destruction of diseased trees were inaugurated in Michigan. An extensive field test of the wilt-resistant cottons developed by the Department demonstrated their superiority to other sorts. Three hundred bushels of the wilt-resistant cowpea, developed by the Department, were distributed throughout the South. In the plant-breeding work the most striking results secured were the fruiting of the new hardy oranges and the "kid glove" pomelo, the latter being an introduction by the crossing of the "kid glove," or Tangerine, orange with the pomelo. Both these productions are highly promising. Small quantities of alfalfa seed from plants resistant to alkali were secured by the agents of the Department. This and other alkali-resistant crops have been distributed extensively throughout the West, where alkali soil conditions prevail. In the cereal work important results were obtained from the distribution of Crimean and other hardy wheats. Hybrids, secured as a result of the crossing of Crimean wheat with other sorts, have proved valuable. The Swedish oats distributed throughout the Northwest, also oats from Russia, have proved very successful. As a result of the Department's efforts in the matter of growing macaroni wheats, about two million bushels were produced during the season. Experiments have demonstrated the value of this wheat for bread making and other purposes. Highly successful results have been secured in the cultivation of nitrogen-gathering organisms, and the Department is now prepared to distribute, in any reasonable quantity, to any part of the country, organisms for all the principal leguminous crops, guaranteed to be good for one year. The practicability of producing an organism capable of inoculating various species of legumes has been demonstrated, but the results obtained indicate that organisms for different hosts give more satisfactory results than a universal form. Highly successful results were obtained in treating reservoirs and ponds for the removal of algæ. The fact that large reservoirs can be quickly and cheaply cleaned has been thoroughly demonstrated. In the work on timber diseases and timber preservation results of importance have been secured. The suggestions made for the preservation and seasoning of timber have resulted in one instance in the saving of more than \$50,000. Extensive experiments on the Pacific coast have demonstrated that a serious disease of walnuts may be prevented to a considerable extent by the proper application of sprays. The work carried on shows that the injuries in most cases were reduced fully 50 per cent. Investigations have shown that considerable quantities of trefoil and other seeds are brought into this country for adulterating alfalfa and other seeds. About 450,000 pounds of Canadian bluegrass seed are imported annually, the chief use of which is to adulterate the higher-priced Kentucky bluegrass seed. Promising results have been obtained in the matter of growing hairy vetch seed in this country. The work in tropical agriculture has brought out the fact that some of the dry

regions of Porto Rico may prove valuable for coffee under improved methods of culture. The discovery has been made that several distinct species of Central American rubber trees are cultivated, and that in Mexico and Central America continuous humidity is not necessary for the highest success of this crop. This discovery encourages the belief that rubber culture may prove profitable in some of our recently acquired territory where it has hitherto been considered too dry for the crop. Encouraging results were secured in the growing of crude drugs in this country. From \$12,000,000 to \$15,000,000 worth of crude drugs are imported annually, and it is believed that a large part of this amount can be kept at home if the proper places and methods for growing the plants can be found. Drug plants are now being grown experimentally in Vermont, the District of Columbia, Texas, Washington, and other States. Successful methods of treating sheep poisoned from eating lupine and camass were discovered. The essential elements in the grading of corn have been learned, and apparatus for measuring them were developed and put into operation. The necessity for a uniform system of grading corn has long been felt, and the apparatus devised will, it is believed, be of great value to the trade in general. Extended work was done in encouraging the growing of alfalfa throughout the East and South. This work was carried on in five States under varying soil and climatic conditions, and the results obtained will throw much light on the possibility of extending this important crop. Similar work was carried on with cowpeas and soy beans in several different parts of the country. Extensive experiments in the improvement of range conditions were inaugurated in Arizona. An area containing 58 square miles was secured through the cooperation of the Department of the Interior. This area was fenced and experiments inaugurated which, it is believed, will throw much light on the improvement of range conditions throughout the West generally. Extensive experiments were inaugurated for the purpose of determining the best methods of utilizing native forage plants for hay. More than 15,000,000 acres of wild hay are harvested in this country annually, and it is believed that this work may be considerably extended. Johnson grass, a serious pest to southern farmers, has been given careful study, and highly satisfactory results in the matter of eradicating it were secured. Systematic work in the extension of our export trade in fruits was continued. Highly satisfactory results were obtained in the shipment of pears, apples, peaches, and other fruits to European markets, the profits in most cases from such shipments being greater than where the same fruit was sold in this country. Improved methods of gathering, storing, and packing fruits for export shipments were devised. The storage work has developed a number of valuable facts. It has been shown that apples and peaches that reach their highest color in growth on the trees, but are still hard when picked, are equal to the less mature fruit in keeping qualities. It has further been shown that delays in storage are most injurious in hot weather and to those fruits and varieties that normally ripen quickly; that the ripening of apples, pears, and peaches in the storage house is delayed more in a temperature of 32° than in a higher temperature, and that the fruit-rots and molds that attack stored fruits are less troublesome in the lower temperature. An extensive experiment in the storage of small fruits, including strawberries, red and black raspberries, blackberries, currants, etc.,

was inaugurated with a view of determining the effect of different temperatures on the keeping qualities, aroma, etc. At the Arlington Farm the work of bringing into condition outlying areas was continued. The work of drainage was considerably extended, and large plantings of cowpeas and other leguminous crops were made. Experimental orchards of apples, pears, plums, and peaches were put out for the purpose of studying the effects of climate on varieties, and also for the purpose of testing insecticides, fungicides, etc. A home fruit garden, covering an area of 1 acre, was planted. A barn, suitable for experimental and other purposes, was constructed. Survey work was continued and permanent avenues, roadways, etc., established. The scope of the tea work was considerably increased. With the cooperation of Mr. A. P. Borden, of Mackay, Wharton County, Tex., ground for an additional tea farm was secured. Fifty acres of tea will be put out at Mr. Borden's place this year, and plans have been made for extending this to 150 acres as soon as plants are available. The total yield of tea at the "Pinehurst" tea plantation in South Carolina for the year was 9,000 pounds. A considerable portion of this was of the highest quality. Black, oolong, and green teas were made, and considerable advancement was secured in the matter of determining the cause of aromas. During the year something over 39,000,000 packages of various kinds of seed were put up and sent out by the Bureau. A large portion of these were in the Congressional distribution, but a considerable part was seed of new and rare plants from foreign countries and hybrids secured as a result of the plant-breeding work in this country. Satisfactory results were obtained in the matter of encouraging the growing of sugar-beet seed in this country. Ten thousand pounds of American-grown sugar-beet seed of high sugar content were distributed.

#### **ORGANIZATION AND WORKING FORCE.**

There have been no material changes in the organization of the Bureau since my last report. The work has been carried on by nine different branches, or offices, the functions of which were fully described in the last report of this Bureau. The working force of the Bureau now consists of 325 employees, 60 per cent of whom are engaged in scientific investigations. As pointed out in my last report, the policy of the Bureau is to constantly encourage advanced work by placing the responsibility for different lines of investigation and research directly upon the men themselves. This policy has a tendency to develop the men, and is believed to aid greatly in advancing the entire work of the Bureau. With the increased amount of administrative duties that has come with the reorganization of the Department it is essential and important that the men charged with the responsible work should get the full benefit of the experience of those in this line who have been longer in the service. With this object in view, the men are being constantly brought together, and methods for strengthening both the administrative and scientific work of the Bureau are discussed, and wherever it is found necessary improvements are made.

#### **COOPERATIVE WORK WITH EXPERIMENT STATIONS.**

The cooperative work with experiment stations has been considerably increased during the year. The Bureau is now engaged in work



of this kind with more than 40 stations, the lines of investigation being exceedingly varied. Many of the more important lines of work have to do with the improvement of our forage-crop conditions, the extension of work on cereals, and studies and experiments having for their object the prevention of serious plant diseases.

#### **COOPERATION WITH OTHER BUREAUS IN THE DEPARTMENT.**

The cooperative work outlined in my last report, carried on with other Bureaus of the Department, has, for the most part, been continued. The cooperative work with the Bureau of Forestry has been considerably enlarged under the direction of Dr. Hermann von Schrenk. In the course of Doctor von Schrenk's investigations, conducted in connection with the Mississippi Valley Laboratory, many important matters pertaining to forests and forest products came under observation. Upon the recommendation of the chief of the Bureau of Forestry arrangements have been perfected for putting Doctor von Schrenk in charge of the division of forest products in that Bureau, maintaining at the same time his connection with this Bureau, as special agent in charge of the Mississippi Valley Laboratory work. This arrangement will enable the Bureau of Forestry to greatly enlarge its scope of investigations in forest products, and will give opportunity for further close cooperation with this Bureau. The Bureau of Chemistry is continuing the cooperative work on special studies of fruits, under the direction of the Pomologist; and is also rendering aid in the cereal investigations, poisonous plant investigations, and the work on drug and medicinal plants.

#### **FARM MANAGEMENT.**

In the last report of this Bureau a plan was set forth having for its object the bringing together of the many varied lines of work being conducted in such a way that the individual farmer or fruit grower could secure the best results from them. It was furthermore pointed out that studies of type farms and farming methods would be inaugurated with a view to securing information which would be of value in sections of the country where conditions were such as to make it desirable to change existing work. This study of farm management was put in charge of Prof. W. J. Spillman, who has devoted considerable time to it during the year. Details of the methods followed on a number of successful farms in different parts of the country have been studied and many valuable facts have been secured for future use.

The result of this work so far shows that the most successful farmers everywhere are those who combine business methods with the teachings of agricultural science. A very important inference to be drawn from the practice of the best farmers whose methods of farming have been studied is that the much discussed principles of crop rotation resolve themselves very largely into a matter of convenience in cropping. The all essential thing, so recognized both in theory and practice by every successful farmer yet interviewed, is to keep the soil well stocked with humus and plant food. Where this is done, paying crops are produced. Where no attempt is made to conserve the humus, the condition of agriculture is deplorable. A portion of the data secured has been embodied in an article in the Yearbook, just published, under the title "Systems of farm management in the United States."

Much study is still required before it will be possible to formulate working plans for farms of different types in the various sections of the country. That more can be learned in less time and at less expense by studying the methods developed by successful farmers than by instituting independent series of experiments is undoubtedly true.

In the prosecution of these studies a farmer has been found who, twenty-two years ago, with no previous experience in farming, took charge of a 12-acre farm in a sadly run-down condition and bearing a mortgage of \$7,200. (This farm is near a large city and the land is consequently valuable as city property.) The live stock consisted of two cows and one horse, and the farm did not produce sufficient feed to keep them. By careful study of agricultural literature and the application of scientific principles the new owner was able to pay off the mortgage in seven years. At the present time this farm furnishes all the feed, except the grain, for 30 head of stock, and last year 2,700 pounds of hay and 600 pounds of straw were sold. The market products of this farm are milk and well-bred young stock, and the net income is not far from \$2,000 a year. The methods followed on this farm can be duplicated on almost any dairy farm in any of the leading dairy sections.

One of the principal objects of these studies is to make known to farmers generally the methods used on such farms as that just described. It is proposed to keep systematic records of the details of the work on a number of such farms and publish them from time to time for the benefit of other farmers, and at the same time it is planned to so coordinate the entire work of the Bureau as to make it feasible to apply the important results secured in the systematic improvement of all rural pursuits.

#### DEMONSTRATION WORK.

It is becoming more and more evident that publications alone are not sufficient to arouse that interest in agricultural advancement which the necessities of the times demand. The work of this Department and of the State experiment stations, supplemented by the agricultural press, is doing much in an educational way. An active demonstration, however, of the superiority of certain crops and certain methods over others is always a striking object lesson and never fails to attract attention. A striking example of this work is to be found in the rice industry of Texas. According to Dr. Seaman A. Knapp, special agent of this Bureau, Texas had 178 acres of rice in 1890. In 1900 there were 8,711 acres and in 1903 approximately 250,000 acres. How much of this wonderful development is due to the work of the Department can not of course be determined. As a result of one demonstration experiment, however, the Department was responsible for the sale and planting of 100,000 acres in one instance alone. The success of this work furthermore encouraged other investments and showed that land which had been considered valuable only for pasture would yield profitable crops of rice.

The demonstration work of the Bureau has been continued and enlarged during the year, and now covers a number of important fields. Particular attention has been given to forage crops, as the necessity for improvement here is imperative, especially in the South. A special effort has been made to encourage the planting of alfalfa throughout the East and South, and to this end the cooperation of a

large number of farmers has been secured in demonstration experiments. In the South, largely through the aid and cooperation of public-spirited citizens, several demonstration farms have been established. These have for their object the encouragement of diversified agriculture, and are conducted on a strictly business basis. In most cases the main expense of this work is borne by the citizens of the community in which the farm is located, the Department furnishing expert advice and working plans. Further details in regard to this work will be found under the reports of the executive officers.

#### FOREIGN EXPLORATIONS.

During the past year five parties of agricultural explorers have been sent into foreign parts, and besides this Hon. Barbour Lathrop has continued to send plants and seeds collected by himself and Mr. David G. Fairchild. One agricultural explorer was sent to Turkestan to secure another consignment of alfalfa seed; one party of two, consisting of a member of the scientific staff of the Bureau of Plant Industry and another from the Bureau of Soils, was sent to Algeria and Egypt in order to find a strain of alfalfa resistant to a larger percentage of alkali in the soil than our common variety will endure, as well as to secure seed of other alkali-resistant crops. A third party was sent to Jamaica to examine and report upon a collection of cassava plants with a view to its purchase and the introduction of these varieties. The fourth expedition went to Mexico in search of varieties of peaches, apricots, and cherries thought to possess advantages over the varieties at present in use; while the fifth explorer, Prof. H. L. Bolley, of the North Dakota experiment station, was commissioned to study flax in European countries with a view to bringing back select varieties for introduction here.

#### ST. LOUIS EXPOSITION.

Considerable attention has been given during the year to the preparation of an exhibit for the exposition to be held in St. Louis in 1904. The exhibit of the Bureau will be divided into two parts: (1) An exhibit in the open air, and (2) an exhibit in the Government building proper.

The open-air exhibit will be unique, and will illustrate the applied work of the Bureau. Ten acres of ground have been secured for this work, the central feature of which will be a map of the United States with the crops of each State growing within its borders. The borders of the States will be cinder walks 3 feet wide. The ground selected slopes in such a way that visitors may see before them at a glance the whole of the United States in miniature with the typical crops of each State growing therein. In addition to the foregoing, the outside exhibit will show practical results in the breeding of plants, the treatment of plants for the prevention of diseases, collections of drug and medicinal plants, collections of fiber plants, etc. Two acres will be devoted to a model school garden in which children will conduct the work.

The indoor exhibit will be illustrative of general research work of the Bureau and will be graphic so far as it is possible to make it. Particular attention will be given to the results accomplished in the studies of plant breeding, the prevention of plant maladies, pure-seed



investigations, etc. It is planned to make the exhibit especially instructive by the presence of living material, such as collections of diseased and healthy plants, fruits, etc., collections of pure and adulterated seed of various kinds, and collections of living specimens of various new plants either introduced from foreign countries or obtained as a result of breeding. Representatives of the Bureau will be present to explain the operations in full.

#### NATURE STUDY WORK.

The great interest now being manifested in nature study has prompted the Bureau to encourage the movement by such means as might legitimately be within its power. It seems proper that the Department as a whole should recognize the value of the work, as its underlying principle is the encouragement of rural life and rural pursuits. There can be no question that this new movement, in addition to its other advantages, will greatly aid agriculture by implanting in the plastic mind of the child a love for agricultural pursuits. With the great amount of material on hand in Washington the Bureau has been able to materially assist in the training of teachers in the normal schools. The horticultural department, under Professor Corbett, has aided in this work, offering facilities in the greenhouses and furnishing material for study and illustrative purposes. The normal school graduates will, therefore, be in position to instruct their scholars in the elements of agriculture as soon as they become teachers, and they will have both practical and theoretical knowledge to aid them. The scholars in the normal schools are encouraged to have home gardens as a means of getting practical experience in horticulture, and 92 such gardens are in operation in Washington this year. Besides the foregoing, efforts are being made to increase the distribution of seed suitable for school-gardens in the Congressional seed work. Members of Congress who have city constituents are becoming interested in this matter and arrangements have been made to supply them with suitable seed for the work in view in lieu of the regular material furnished.

#### REPORTS OF EXECUTIVE OFFICERS.

In the accompanying reports are given summarized statements of the principal officers of the Bureau.

#### VEGETABLE PATHOLOGICAL AND PHYSIOLOGICAL INVESTIGATIONS.

The pathological and physiological work of the Bureau, directed by Mr. A. F. Woods, has made rapid progress during the year. The main problems considered may be briefly reviewed under the following heads:

##### PATHOLOGICAL WORK.

GENERAL LABORATORY WORK.—Dr. Erwin F. Smith and his assistants in the Pathological Laboratory have made microscopical and cultural examinations of a large amount of miscellaneous material received from all parts of the country, including the Hawaiian Islands and Porto Rico. Full reports and recommendations for treatment were furnished the applicants. The study of the life history of the organisms causing the brown-rot of turnips was completed during the year and a bulletin

describing the disease issued. A new bacterial disease of plums was also investigated, and a paper describing it is nearly ready for publication. An extensive series of field experiments was started to determine, if possible, the causes of the susceptibility of potatoes to the soft rots, and to learn whether the potato can be modified by soil treatment with fertilizers so as to become resistant to these rots.

Several new bacterial diseases of plants have been discovered and some work has been done on each of them. The gum disease of sugar cane was proved to be of bacterial origin, and inoculation experiments carried out in the Department greenhouses show that there is a very marked difference in varietal resistance to this disease.

Further experiments were carried out during the year on the bacterial disease of sweet corn first discovered and studied by Stewart, of the New York experiment station. The work demonstrated that at least one of the most important means of infection in the spread of this disease is through the water pores on the tips of the young leaves in the seedling stage. It is known that some varieties of sweet corn are more resistant than others, and it is believed that by practical selection resistant sorts may be obtained.

**DISEASES OF SUGAR BEETS.**—The work on sugar-beet diseases was continued during the year by Dr. C. O. Townsend. A large number of experiments was carried on looking to the control of leaf-blight. This disease is very serious in all of the best sections from Nebraska eastward, and annually does thousands of dollars damage in reducing the tonnage and sugar content of the beets attacked.

Two lines of experiments were carried out, viz, spraying and soil treatment. The spraying experiments with Bordeaux mixture were entirely satisfactory in holding the disease in check, and resulted in an increase of approximately 50 per cent in the tonnage. No conclusive results were obtained from the soil treatment.

Further investigations were made of the disease known as "curly-top" of beets. The results indicate that this trouble is not of parasitic origin. Several hundred selections were made with the hope of finding a strain of beets resistant to this trouble.

Preliminary investigations of beet-leaf rust, root-knot, and several other diseases were begun during the year.

**BULB-ROT OF CALLA LILY.**—This serious disease of the calla lily has been under investigation by Doctor Townsend for some time. The cause of the trouble has been discovered, and a report on the subject is now in course of preparation.

**CRANBERRY DISEASES.**—In this work Mr. C. L. Shear has demonstrated that there are two, and possibly three, distinct diseases which cause serious injury to the cranberry. One, known as blight or blast, attacks the young fruits and often destroys 50 per cent of the crop. The second disease of importance is known as rot or "scald," and does the greatest injury to the ripe fruit. It is believed that the fungi causing both of these troubles have been discovered, and their life history is now under investigation. Spraying experiments for the control of these diseases were started this spring and will be continued during the season. Selections of resistant strains have also been made. The cranberry growers have taken a great interest in this work and are aiding in the investigations in every way possible.

**DISEASES OF ORCHARD FRUITS.**—The special investigations of the diseases of orchard fruits have been continued by Mr. M. B. Waite and his assistants. The spraying experiments in Albemarle County, Va., demonstrated that the Newtown Pippin apple orchards may be safely sprayed with Bordeaux mixture for bitter rot and other fungous diseases without secondary injury to the fruit from the Bordeaux mixture. A comparison of the sprayed and the unsprayed fruit in cold storage brought out the fact that the sprayed fruit is much less subject to barrel "scald."

Further tests were made of the effect of sprays on peach and plum trees. The rot, which is the most serious disease of these fruits, could be controlled by spraying if the sprays did not so seriously injure the foliage. Several modifications of Bordeaux mixture and potassium sulphid solution were tried during the season, but were not satisfactory. The most favorable results were secured by a method suggested by Prof. S. M. Bain, viz, first spraying with dilute milk of lime, following with the ordinary Bordeaux mixture. So far the results of this method have been satisfactory, but extensive field tests will have to be made before definite conclusions can be drawn.

The work on "little peach" was continued in Michigan and New York. The trouble has proved to be fully as serious as anticipated. Mr. Waite has demonstrated that, like "yellows," "little peach" is transmitted by budding and must be handled the same as "yellows." The peach growers have been advised of this fact and many are rooting out the diseased trees as soon as detected. A cooperative experiment has been arranged with the Michigan authorities to conduct a campaign in cleaning the disease out of the Michigan orchards. This work will be done under the supervision of our experts.

In pear-blight, our attention has been devoted during the past year to demonstration work. This has been carried on in four different States, viz, Georgia, Texas, Colorado, and Maryland. In North Georgia the experiment was successful, the disease being entirely eradicated from the experimental orchards. In the south Georgia experiment, while the disease was not so completely eradicated, the treatment greatly improved the condition of the orchard as compared with surrounding untreated orchards. In Colorado no direct experiments were undertaken, but a trip was made through the principal fruit sections by Mr. Waite, and demonstrations and lectures were made in the orchards, showing exactly how the work should be done. The fruit growers took a great interest in the work, and it is believed that they will succeed in cleaning the disease out of their orchards. The experiment is not yet completed, but will be finished during the present season.

Investigations were also made during the year of root-rot of the peach, which is very prevalent in portions of the South, and also of a new plum disease which has destroyed many orchards in Georgia.

**GRAPE DISEASES.**—Mr. A. W. Edson carried out a series of experiments at Tryon and Southern Pines for the purpose of demonstrating the method of controlling black-rot. This disease has made it almost impossible to grow certain tender varieties. The work was undertaken in cooperation with the State experiment station, and demonstrated that the rot can be controlled by thorough and careful spraying. A report on the work was prepared by Mr. Edson, and will be published by the North Carolina experiment station.



**WILT DISEASES.**—Mr. W. A. Orton has continued the investigation of wilt diseases of southern crops. This class of diseases has proved to be one of the most serious with which the southern farmer has to deal. The work has included further studies of cotton wilt, cowpea wilt, watermelon wilt, tomato wilt, and cabbage wilt, as well as some preliminary investigations of pecan and mulberry diseases. The results obtained in each case are briefly summarized below:

*Wilt in Sea Island cotton.*—The selection of resistant varieties has been continued, and in a severe test on a large scale under practical conditions in South Carolina and Georgia, the wilt-resistant strains already secured proved to be entirely satisfactory, yielding a large crop of superior quality on badly infected land. The Rivers Sea Island cotton was the best of these resistant strains, and 200 bushels of seed grown especially for the Department were distributed to planters in Georgia and Florida, where the disease is very injurious. The wilt-resistant Sea Island varieties are not thoroughly adapted to the special conditions in other localities, but it has been found that by a few years' selection this difficulty can be entirely overcome.

*Wilt in Upland cotton.*—Field observations have shown that this disease is more widespread than was supposed, causing heavy losses over wide areas. Field tests were made of a large number of wilt resistant selections, some of which proved to be entirely wilt-resistant and of good quality. A limited quantity of the seed of these resistant strains was obtained, and a large crop is now being grown from this seed. It is planned to continue this work in the improvement of disease-resistant strains until sufficient seed is available for the distribution of all of the varietal types needed in the infected regions.

*Cowpea wilt.*—During the past year comparative tests of all obtainable varieties of cowpeas were made on infected land at Monetta, S. C. The remarkable resistance of the variety known as "Iron" to both wilt and root-knot was maintained, and its great value for use on disease-infected soils was corroborated by tests made by many farmers. Three hundred bushels of seed of this variety were distributed through the Congressional seed distribution this year. In response to the demand for a more productive variety, the further improvement of the Iron cowpea is being attempted. Hybrids have been made and selections undertaken.

*Watermelon wilt.*—The aim of this work is to produce a resistant variety of good quality, and the results of the past year were very encouraging, though the problem is not yet settled. The citron and some foreign melons have proved to be wilt-resistant, and hybrids between them and the native varieties were also resistant and immensely productive, but it is not yet known whether a good type can be fixed. We succeeded last season in obtaining resistant selections from American varieties, and it is hoped that the desired result can be obtained without hybridization. Field work is being carried out this year on 10 acres of land at Monetta, S. C., in cooperation with the Congressional seed distribution.

*Tomato wilt.*—Work was started during the year in the investigation of this disease, which is closely allied to the wilts of cotton and other crops. Mr. Orton, in collaboration with Professor Rolfs, at our sub-tropical laboratory in Miami, Fla., made a general survey of the areas

where tomatoes are grown in the South, and found the wilt to be extremely widespread and destructive. The tomato industry brings \$3,000,000 annually to Florida alone, and thousands of truckers are interested in the crop. Most of them find it necessary to have new land every year, as the wilt disease makes it impossible to cultivate the crop very long in one place. We believe that it will be feasible to secure wilt-resistant varieties, and steps to this end have already been taken.

*Cabbage wilt.*—This disease is widespread and is the cause of much loss to growers of this crop. Although work was started on it during the year, it has not been possible to make much headway on account of the pressure of other investigations.

*Pecan diseases.*—The growing of pecan nuts has become an important industry in many sections of the South, and large orchards are now just coming into bearing. Several serious and destructive diseases have developed, and the preliminary study of these was undertaken by Mr. Orton in cooperation with the Georgia State entomologist during the year. One disease, known as "rosette," kills the trees and is apparently to be classed with peach "yellows" and peach "rosette." The other is a scab of the nuts caused by a species of *Fusicladium*. A study of these troubles and experiments in their treatment are well under way.

*COTTON ROOT-ROT.*—The work on this disease, which does the greatest damage in the southwestern cotton areas, has been continued by Mr. Shear. Although the disease is of parasitic origin, the fungus causing it has never been identified with certainty. As a result of the studies made during the year, it is believed that the identity of the fungus has been discovered, but the work is not yet sufficiently far along to make a definite statement on this point. Several selections were made from apparently resistant varieties, and these have been planted this spring, and further selections will be made in the fall.

*TOBACCO DISEASES.*—A careful study has been made during the year of practically all the important diseases that affect tobacco. Besides the laboratory work, Dr. R. E. B. McKenney has visited the principal tobacco-growing areas and studied the distribution and behavior of the diseases in the field. A report covering the work is now in course of preparation.

#### PLANT-BREEDING LABORATORY.

The investigations of the Bureau of Plant Industry on the improvement of plants are conducted by the Plant-Breeding Laboratory, under the immediate supervision of Dr. H. J. Webber. The time and energy of the scientific staff of this laboratory are taken up principally in practical plant-breeding work, but in the course of the investigations careful attention is also being given to the laws governing the improvement of plants, and many principles of importance in plant breeding have been deduced.

In the selection of problems for investigation great care has been exercised to take those most important and promising in practical results. All experiments are undertaken with definite aims in view, which give evidence of their possible accomplishment within reasonable time. Following is an outline of the main lines of investigation.

**COTTON.**—The greatest problem in cotton breeding is to secure new races of long-staple Upland cottons, giving good yields comparable with those of ordinary Upland races and being thoroughly adapted to growth in Upland cotton regions. The demand for long-staple cottons is constantly increasing and the extension of cultivation in areas where such cotton can now be grown can not long supply the demand. It is thus of the greatest importance that these experiments be pushed as rapidly as possible. The long-staple Upland sorts now cultivated are light yielders and have a rather weak fiber and tufted or fuzzy seeds, so that they can not be satisfactorily ginned on a roller gin. If ginned on a saw gin the fiber is more or less torn and injured. By hybridizing the fine, long-staple Sea Island cotton, which has smooth, black seeds, with the big-bolled, short-staple Upland sorts, which have fuzzy seeds, it is hoped to produce new Upland sorts having big bolls, being easy to pick, and having black seeds and long, strong lint. Some 40,000 hybrids have been grown in the course of these experiments, and several types have been selected which, in general, give promise of meeting the requirements. These plants are being carefully selected and bred into fixed types, and it is confidently expected that some of these will produce valuable new sorts. It is highly desirable to secure good varieties possessing the qualities mentioned above and having a fiber ranging from  $1\frac{1}{4}$  to  $1\frac{3}{4}$  inches in length. This requires the selection of a number of varieties, each having fiber very uniformly of the same length, and several different types are therefore being bred with fibers of different average lengths but in all cases longer than that of ordinary Upland cotton.

Besides the production of new races by hybridization, much can be accomplished by a straight selection of the best long-staple races now existing, particularly with reference to length and strength of staple. Experiments of this kind have also been inaugurated, the aim being to ultimately secure highly improved pedigree seed for distribution.

Another important line of work which is receiving considerable attention is the introduction and establishment of Egyptian cotton growing in this country. There is annually imported about \$7,500,000 worth of this cotton and the demand for staple of this character is rapidly increasing, while the area in Egypt suited to its culture is very limited and can be only slightly extended. When first introduced Egyptian cotton ordinarily gives a very light yield and the fiber tends to lose some of its essential characteristics. It is believed, however, that varieties which will prove profitable for general cultivation can be bred to suit American conditions. One variety which has been selected in South Carolina for three years gives considerable promise of value, and will soon be ready for distribution if its quality holds up. This is being cultivated in considerable area the present season. A second variety, produced by crossing Sea Island cotton with Mit Afifi Egyptian, has been selected to resemble the Egyptian type of fiber, and last year gave a very excellent yield of fine fiber, but rather variable in length. This is also being cultivated on a comparatively large scale, and will soon be ready for distribution if it holds up in yield and can be improved slightly in uniformity. Imported strains are being tested and bred in Georgia, South Carolina, Mississippi, Texas, New Mexico, Arizona, and southern California. Samples of the fiber grown last year in experimental patches have been submitted to competent authorities for expert opinion as to quality and value, and actual manufacturing



tests of the fiber are also being made. While there are some failures, the product in many instances is pronounced equal to the best imported fiber. The indications at the present stage of the experiments favor the belief that we will ultimately be able to secure varieties fully adapted to cultivation in this country.

In the breeding of disease-resistant cotton very important and marked results have been attained, particularly with sorts resistant to wilt or black-heart. These points, however, are fully discussed under other heads. From a study of the conditions it seems possible that varieties can be originated which will be resistant in some degree to the cotton root-rot of Texas and to the much-feared boll weevil. Work on these two problems has been started in a small way and should be pushed. In order to avoid injury by the boll weevil, as shown by the work of the Division of Entomology, varieties maturing earlier than those now existing should be produced. While this is very important and investigations with this object in view are strongly urged by growers, it has thus far been impossible to undertake the work.

CORN.—The development and acclimatization of at least one superior strain of corn for each of the various geographic sections of the United States is the leading line of corn-breeding work in progress. This work is receiving most attention because the creation of such corns will meet the immediate needs of the growers of the different sections and enable them to raise more and better corn without increasing their labor and expenses. The production of varieties richer in protein and oil, and of varieties suited to specific purposes, such as the making of grits and hominy, is receiving attention, but the present demand of growers throughout the country is for corns that will withstand their particular soil and climatic conditions and produce more plentifully than the types they are now growing. To meet this demand the present force and funds are being largely used. The work is being pursued by first ascertaining, by the accumulation of experiences of careful corn growers, supplemented by variety tests, the sorts best suited for foundation stock with which to begin in the various sections of the country. When this is determined the work consists in continuously growing the strain in the particular district and improving it in productiveness, market quality, and uniformity, by strict seed selection, till it possesses sufficient superiority to establish itself with the growers of that section. In the few sections where this work has been in progress two or more years, growers have before them an object lesson proving that well-bred and selected seed will often produce 16 bushels more per acre than the seed generally planted.

Some work along similar lines has been begun with varieties of sweet corn to improve their productiveness, tenderness, and sweetness. The production of varieties suited to sections where sweet corn is not now grown is receiving attention. Hybridization work is being pursued for the purpose of originating types that will meet needs not filled by existing types, and, in certain cases, to combine in one variety the good qualities possessed by the chosen varieties. Last year's comparative tests of fire-dried and air-dried seed showed a profitable superiority of the former, and these tests are being repeated this year. A strong tendency of individual seed ears, possessing high or low percentages of grain to cob, to transmit such qualities to the progeny, was well established by the experiments of 1902.

**OATS.**—As yet the work done in oat breeding is mainly of an experimental character. The limits of variation in progeny of individual plants are being studied. The methods used in crossing have been put on a firm basis, and the reasons for failure are now fairly well understood.

Among the problems taken up is the production of an oat better suited for the manufacture of oatmeal. The naked or hull-less varieties seem to be the proper basis for this work, and some promising selections and hybrids are being grown. Increased size of grain and a small percentage of hull, with an absence of empty hulls and "double oats," are desired in the oatmeal trade, and numerous selections to attain these objects are being grown.

The production of a hardy white winter oat has been undertaken, and some of the selections already made promise well. The extension of the limit of the winter oat through selection of hardier varieties of the southern winter sorts is one of the main propositions in winter oats.

The origination of varieties of spring and winter oats resistant to lodging, rust, smut, etc., is being taken up in the different oat regions with farmers interested in the matter, and in cooperation with State experiment stations. In many sections oats are used in rotation on very rich ground, and often a very large share of the crop is lost through the lodging of the straw, where a variety with a stiffer stem would remain standing.

**CITROUS FRUITS.**—The great problem before the orange, lemon, and grape-fruit growers is the production of hardy sorts resistant to cold. By crossing the *Trifoliata* orange, which is hardy throughout the North, but which produces a worthless fruit, with the fine but tender varieties of the sweet orange and lemon, it is hoped to originate hardy or frost-proof oranges and lemons with good, edible fruit. Some of these hybrids have now fruited and the results obtained are very encouraging. Two sorts produce fruits much larger than those of the *Trifoliata*, juicy, nearly seedless, and of fine texture. They make a fine "ade" like that made from lemons or limes, but are rather too acid to eat from the hand. They will probably prove valuable also for culinary purposes, and the trees give promise of being useful evergreen hedge plants. The greatest value of these productions, however, lies in the fact that they are probably the progenitors of numerous other excellent varieties.

A loose-skinned "kid-glove" pomelo, a cross of the pomelo and the Tangerine orange, has also been obtained which gives promise of value and is being propagated for distribution. Many other hybrids are being grown which have not yet fruited, and further important results are confidently expected.

**PINEAPPLE.**—About three hundred hybrids of various kinds of pineapples are being grown and many of them have now fruited. Only one smooth-leaved variety at present exists, and the origination of smooth-leaved sorts was one of the primary objects of the experiments. The superior quality of the hybrid varieties which have been secured is remarkable. Among them are many different sorts with smooth leaves, some of which will probably prove valuable. The promising sorts are being propagated as rapidly as possible to obtain stock for distribution.

**OTHER BREEDING EXPERIMENTS.**—A number of other breeding problems are also receiving attention. Numerous potato seedlings are being grown, and the best foundation stocks for important improvements are being studied. A careful study of the laws governing hybrids is being made, and important conclusions have already been reached. The importance of the individual in selection is also under investigation, and in some cases in corn and cotton it has been demonstrated that selection must be carried to parts of individuals, as to certain grains or bolls, to secure the desired result in the quickest and surest way. The prepotency of species, the general laws of combinations of characters in hybrids, and other important questions in breeding still in doubt are being investigated.

#### ALKALI CROP INVESTIGATIONS.

The work of securing strains of the more important field crops in the arid and semiarid regions which can endure greater amounts of salts or alkali in the soil than these crops ordinarily withstand, is being steadily prosecuted. Attention is being paid both to the importation from other countries of existing strains adapted to this class of soils and to breeding such strains by continued selection of seed from more resistant individuals found among the crops grown on alkali lands in the United States.

A visit was made last summer to Algeria and Egypt by the physiologist in charge of this line of investigation in the Bureau of Plant Industry, accompanied by a member of the Bureau of Soils. In addition to obtaining much information in regard to the handling of salt lands in those countries, a small quantity of seed of alfalfa was secured in Algeria from plants exposed to larger amounts of salt in the soil and in the irrigating water than this crop has been found to endure in the United States. During the same summer another agent of the Department secured in Turkestan a limited quantity of seed of alkali-resistant alfalfa. Seed of these two kinds of alfalfa was sown this spring at a number of places in the West and Southwest, with a view of testing their adaptability to conditions there, and especially to ascertain what amount of alkali they will withstand. Other plantings will be made this coming fall. At the same time experiments with barleys and wheats imported from north African countries by the Department will be started to ascertain their value as alkali-resistant varieties. Information obtained in Algeria indicates that oats are distinctly resistant to moderate amounts of alkali, and the testing of this important cereal crop on salt land is a line of investigation that will be taken up as soon as possible.

In all cases the stand obtained will serve as a basis for plant-breeding work, a careful selection being made from the individual plants that make the best growth in the presence of the largest amount of alkali. There is increasing reason to hope that strains of alfalfa, and possibly also of wheat and barley, will be obtained that will grow in half again as much alkali as the sorts ordinarily cultivated in the Western United States.

Cotton was found in Egypt to be a decidedly resistant crop, a fact which has also been noticed in western Texas. Consequently, a moderate amount of alkali in the soil should not be an obstacle to the cultivation of this crop in the Southwest. Yet, the securing of a more



resistant race, so far as this can be done without deterioration in other respects, is obviously important if this staple is to be extensively grown in regions where alkali is a factor to be reckoned with.

While attention at the beginning of this line of investigation must necessarily be focused upon a few of the most important field crops, the development of alkali-resistant strains of all crops now grown in the region affected or suitable for growing there is an end to be kept steadily in view. This may be accomplished in some cases by importing from other countries varieties that are already resistant to alkali; in other cases by breeding the more resistant individuals in varieties already grown in the Western United States. Often the combination of these two methods will be found desirable.

In cooperation with the Physiological Laboratory, it is planned to continue and extend during the coming year laboratory experiments on the resistance of different economic plants to the effect of the different alkali salts, singly and in mixtures. When it is considered that we do not yet know whether a race of alfalfa or barley when bred for greater resistance to "white alkali" will be proportionately more resistant to "black alkali," or even whether it will be equally resistant to all of the different types of "white alkali," the direct practical bearing of such laboratory experiments becomes obvious. A few months of experiments in the laboratory may save years of much more costly work in the field.

Every step forward in this line of investigation shows more clearly the great complexity of the factors involved, and a proper arrangement of the breeding experiments so as to obtain conclusive results offers serious difficulties. Yet, in view of the very great importance of this question in the irrigated section, no effort should be spared to bring it to a successful issue.

#### CEREAL INVESTIGATIONS.

This work was carried on during the past year under the immediate supervision of Mr. M. A. Carleton, and falls chiefly in four lines, namely (1) the establishment of introduced varieties of grain, in cooperation with the office of Seed and Plant Introduction and Distribution; (2) the development of new varieties of wheat by breeding, in cooperation with the Plant-Breeding Laboratory; (3) cooperative work with the State experiment stations along these lines; and, (4) chemical studies of new and introduced varieties of grains with reference to their value for producing bread and macaroni, in cooperation with the Bureau of Chemistry.

IMPROVEMENT IN WINTER WHEATS.—This line of work has been under way for two years, but is now being carried out on a more extensive scale, and more thoroughly, as a result of the practical completion of the work on macaroni wheats. The results of our experiments have already made it possible to grow winter wheat much farther north than before, so that it is probable that Nebraska and Iowa may soon become winter-wheat States instead of spring-wheat States, thus increasing the yield per acre 5 or 10 bushels above the present spring-wheat yield.

Crimean wheat, introduced on recommendation of the Department, is now being grown everywhere in the hard winter wheat districts, and the Kharkof and Beloglina varieties are found to be still more

hardy. A large amount of work in hybridization and selection has been done with winter wheats. Out of several thousand hybrids produced about 200 show indications of being far better fitted for certain portions of the United States than any sorts now known.

**IMPROVEMENT IN SPRING GRAINS FOR THE NORTHWEST.**—The Swedish Select, Tobolsk, and Sixty Day oats, varieties introduced from Russia in cooperation with Seed and Plant Introduction and Distribution, have now become well established in the Dakotas, Minnesota, and Wisconsin, and are very generally recognized as a great improvement over the ordinary local varieties. The Hanna barley, another Department introduction, has proved very much more valuable than any of the other barleys grown in that section, and it is particularly valuable in the region from Wisconsin to Montana.

**BREAD FROM MACARONI WHEATS.**—The macaroni wheat industry is now so well established as to make the experimental stage a thing of the past. However, a very important work was carried out during the past year showing the value of these wheats for bread making. After several private experiments by different bakeries, an exhaustive test of macaroni wheat flour for making bread was carried out on an extensive scale by this Department in cooperation with one of the leading bakeries of the country. An examination of over 200 loaves of one of the bakings in comparison with an equal number made from the ordinary hard spring wheat flour by selected experts among the millers, bakers, flour inspectors, grain dealers, and teachers of domestic economy throughout the country, resulted not only in demonstrating conclusively that the macaroni wheat may be readily used for making bread, but that bread made from macaroni flour is superior on the whole to that made from ordinary spring wheat flour.

**WINTER GRAINS FOR THE SOUTH.**—The development of much hardier varieties of winter oats and winter barleys for the South is a very pressing problem in cereal cultivation, and has already received some attention during the last year. The experiments so far made show that the crop of winter oats particularly can be made certain by establishing slightly hardier varieties than those now grown. Certain hardy varieties of winter oats have been tested in Kansas with remarkable success, surviving the winter equally as well as some of the hardiest winter wheats. It is planned to test these and other hardy varieties more fully in the South.

**CHEMICAL STUDIES OF GRAINS.**—This phase of the work has been carried on in cooperation with the Bureau of Chemistry by Dr. J. S. Chamberlain. The chemical study of macaroni flours has enabled us to make more careful comparisons than would otherwise have been possible, and first led us to the conclusion that these wheats might be used successfully for bread making. A considerable amount of original investigation has been carried on with special reference to the nature and composition of gluten and the effect of climate and soil upon the composition of this and other elements of the wheat kernel.

**COOPERATIVE WORK WITH THE STATIONS.**—Much of our experimental work with cereals has been carried on in cooperation with the State experiment stations. Especially valuable results have been secured in Kansas and South Dakota. In the latter State the work was principally with oats and macaroni wheat. A bulletin giving the

results of these experiments is now in preparation by the Department, and one has already been published by the State station applying to the particular work of that region. Much work has also been accomplished in cooperation with the stations in Texas, Nebraska, Minnesota, North Dakota, Wisconsin, Maryland, and Tennessee. In all of these places extensive tests and breeding experiments are under way.

#### LABORATORY OF PLANT PHYSIOLOGY.

There have been two principal lines of work with which the Laboratory of Plant Physiology has been concerned during the past year, namely, the investigation of the organisms producing tubercles upon legumes and other nitrogen-fixing bacteria, and the attempt to find some efficient remedy for the pollution, by algae, of lakes, reservoirs, and other sources of water supplies. The investigations in this laboratory are under the immediate direction of Dr. George T. Moore.

#### CULTIVATION OF NITROGEN-GATHERING ORGANISMS.

At the time of the last annual report a number of important facts had been discovered relative to the propagation, cultivation, and distribution of the tubercle-forming organisms, which promised to be of great assistance in producing a practical method of soil inoculation. It has been the aim of the laboratory during the last year to test these methods as thoroughly as possible before they came into general use, and to perfect to the highest degree the process of growing, preserving, and distributing the cultures. While no single discovery has been made which would compare with the fundamental principles established last year, a number of minor points have been perfected which will add much to the success of the entire process. Improved methods of preparing and drying the cultures have been worked out; the best time of year to secure the original organism from the host plant has been established; the method of mixing the nutrient solution has been improved by delaying the addition of the ammonia salt for twenty-four hours, thus giving the tubercle organism a decided advantage in growth over any foreign bacteria which might be introduced; the most economical method of packing has been devised, and numerous other improvements have been made. As the result of these experiments and the perfection of methods first established last year, *we are now prepared to distribute in any reasonable quantity, to any part of the United States, organisms for all the principal leguminous crops, guaranteed to be good for one year.*

From experiments that were under way at the time of the last annual report, certain definite results have been obtained. The practicability of producing an organism capable of inoculating various species of legumes was demonstrated on the Arlington Farm by means of numerous cross inoculations, and the possibility of securing a universal organism capable of producing tubercles on all legumes is assured, should such an organism become necessary. For the present, however, it seems better to continue to furnish specific organisms for specific crops, for the reason that the slight physiological difference which naturally exists in the bacteria from different hosts gives that organism a slight advantage at the first and enables it to produce a more abundant crop of tubercles in a shorter length of time than could ever be possible with a "universal organism."



The effect of the artificially modified organism grown on nitrogen-free media was clearly demonstrated in the field. Rows of legumes, inoculated with the cultures grown in this way, were covered with tubercles, while within 4 feet of these plants similar legumes inoculated with cultures grown on the old style nitrogenous medium failed to produce a single tubercle.

So far as the experiments of the Arlington Farm demonstrated there seems to be little difference in the relative advantage of seed over soil inoculation. The result of the trials last year go to show that either method can be used according to convenience and practically the same result will be obtained.

A large number of experiments were under way last year to determine, if possible, the effect of various mineral salts upon the tubercle organism. The salts of lime, magnesia, ammonia, etc., were tried and information obtained which will be of considerable value in further work along this line. It would seem from experiments thus far that the effect of mineral salts upon the tubercle organism is practically the same as upon the host plant, and that it is not necessary to distinguish between the two results. In case it should be necessary to produce an organism adapted to certain special conditions, such as an alkali soil, there is little doubt that it could be grown, but until the crops for alkali and similar conditions are more definitely determined, the work on such specially adapted organisms need not be continued.

A patent to cover the important operations connected with the cultivation and distribution of the tubercle organisms has been applied for. This was done in order to insure control of these cultures by the Department and to prevent irresponsible parties from attempting to distribute similar organisms.

An article, covering in a general and popular manner the essential points concerned in the relation of bacteria to the fixation of free nitrogen, was prepared and published in the Yearbook of the Department for 1902.

**WATER CONTAMINATION BY ALGÆ.**—The methods, reported a year ago as so successful in connection with the cress beds, have been widely extended during the past winter, and it is believed will prove of universal application where cases of algal pollution exists. Three months were spent in the investigation of the conditions existing in the Massachusetts and Metropolitan Water Supplies (the city of Boston and all towns within a radius of 10 miles), and much valuable information was obtained this way. It is hoped that by next year a definite statement can be made. An article was prepared for the Yearbook for 1902 setting forth the character of the work to be undertaken, and it is believed that it will be of considerable assistance in bringing the subject before the public and those most interested.

As the result of information gained while working in Boston, it was possible to arrange with the Boston Board of Health to treat several large reservoirs and ponds, with the idea of preventing their pollution by algæ. These ponds range from a capacity of 5 million to 500 million gallons, and are particularly well adapted for testing the efficacy of any method tried. In addition to the reservoirs in the vicinity of Boston, an entire lake is to be treated in New York State, as also the reservoir of the Winchester (Ky.) waterworks. The latter will afford an unusual opportunity for trying any methods calculated to prevent

pollution by algæ. Here the taste at certain times of the year renders the water unfit to drink, and the odor is so obnoxious as to make sprinkling the streets and lawns an impossibility.

#### MISSISSIPPI VALLEY LABORATORY.

The work at the Mississippi Valley Laboratory during the past year has been of two kinds: (1) Distinctly pathological work, and (2) work in cooperation with the Bureau of Forestry in connection with problems on timber preservation. The work in this laboratory is under the immediate direction of Dr. Hermann von Schrenk.

#### DISEASES OF TIMBER.

THE "BLUE" DISEASE OF THE WESTERN YELLOW PINE.—Considerable work was accomplished and practically brought to a conclusion dealing with the "blue" disease of Western Yellow Pine. Some 600 million feet of pine timber in the Black Hills Forest Reserve of South Dakota are affected with this disease, and it was a matter of a great deal of importance to determine the cause of the disease and the extent of injury to the timber. The investigation showed that the disease was due to a fungus, which, however, did not injure the strength of the wood, so that it was found that the blue wood could be used with perfect safety. We believe that the result of these investigations is of very great practical importance in assisting the people of the Black Hills toward the use of this timber.

CATALPA DISEASE.—During the year the investigation into the cause of the disease of the catalpa trees was continued and the results were published in a bulletin of the Bureau of Forestry. This disease caused the destruction in Kansas of thousands of catalpa trees just ready for marketing in the form of fence posts. The loss may be estimated at \$5,000. The cause of the disease was determined, and methods were devised for preventing its appearance in catalpa plantations in the future.

DISEASES OF SHADE TREES.—Considerable progress was made during the past year in the investigations dealing with diseases of shade trees. A disease of the White Ash was studied with considerable care, and a bulletin published concerning it. This disease is a very serious one in parks and grounds, and it is thought that the researches made will show how this trouble can be almost completely avoided.

DISEASES OF THE REDWOOD.—An investigation was made and the results were published in a bulletin of the Bureau of Forestry concerning the diseases of the redwood in California.

TIMBER PRESERVATION AND SEASONING.—The work of timber preservation and seasoning was conducted in cooperation with the Bureau of Forestry. The saving caused by improved methods of cutting the timber to insure longer life has already been very great. In one instance about \$50,000 was saved in six months. The work was planned so as to deal with the following phases:

*Seasoning.*—Extensive seasoning tests were carried on in cooperation with railway, telegraph and telephone, and mining companies to determine the amount of water evaporated from timber. This evap-

oration led to saving in freight, increased length of life of the timber, and economy in handling. In certain instances the timber was dried out to such an extent that 39 per cent of weight was lost, maintaining a great saving in freight and better timber for treatment.

*Tests with preserving processes.*—Tests with preserving processes to prevent decay were conducted at two points. A new process was experimented with, giving excellent results. The practical cooperation of the users of timber with respect to this question was secured all over the United States.

#### DISEASES OF FRUIT TREES.

**BITTER-ROT.**—Field spraying experiments and culture experiments were carried on during the present year with the result of determining definitely the cause of the bitter-rot disease and the finding of its winter stage. It is believed that the methods advocated and published in the bulletin on this subject will result in the saving of a very considerable proportion of diseased fruit in the future. This disease last year destroyed over \$10,000,000 worth of fruit.

**CROWN-GALL.**—The crown-gall disease of fruit trees at present forms a very considerable menace to nursery growers. Preliminary experiments have been conducted to determine the manner of infection of nursery stock. Some 250 varieties of fruit trees are now under cultivation to determine whether it will be possible to find a variety resistant to this disease. In the experiment the following fruit trees are included, viz, apple, pear, quince, and almond, and, besides fruit trees, raspberry and blackberry bushes. The infectious nature of the disease was again demonstrated.

#### SUBTROPICAL LABORATORY AND GARDEN.

The location of the Subtropical Laboratory and Garden at Miami, Fla., is the only place in the United States where we can find conditions essentially tropical. Mr. P. H. Rolfs, who has charge of this laboratory and the garden, has carried on, for various branches of the Bureau, quite extensive tests of forage and fiber plants and tropical and subtropical fruits, especially those introduced from foreign countries.

Several diseases of the orange have developed and spread with considerable rapidity since the great freeze in 1899. Among these the greatest loss comes from the disease known as "blight," which attacks the most valuable and fruitful trees. The cause of the trouble has not yet been discovered, and the work will be continued during the next season.

The diseases known as "dropping" and "splitting" were investigated, and it is believed that remedies will soon be found for these difficulties.

Considerable work was done on the "leaf-spot" of pineapples, on tomato wilt, and on the seedling blight and the mosaic disease of the mango. The cause of a serious disease of the avocado was discovered, and a remedy will be tested. Work along all these lines will be continued and enlarged during the coming season.

The work done at this laboratory on citrous and pineapple hybrids is discussed under "Plant breeding."



## MUSHROOM WORK.

During the latter part of 1901-1902 some success was obtained, under the direction of Dr. B. M. Duggar, in the germination of mushroom spores by means of chemical stimuli. Experimentation along this line has been continued, and it has been definitely ascertained for the first time that several chemical agents will induce germination of the spores of *Agaricus campestris*.

Owing to some difficulties in the way of obtaining pure cultures without fail by this method, an entirely new and satisfactory method of obtaining pure cultures has been worked out. This consists in using, instead of spores, bits of the inner flesh or tissues of the sporophore as a source of material for inoculation purposes. By this method pure cultures have been obtained of numerous fleshy fungi, among them being several species of puffballs, none of which had previously been obtained in culture.

A considerable amount of spawn of *Agaricus campestris*, as pure cultures, has been grown, and is being tested by practical growers. Trial beds at Columbia, Mo., have shown the pure spawn to be superior to all other sorts tested.

Practical methods of using the pure spawn in the manufacture of a less expensive crop spawn have been under study, and what appears to be a high grade of spawn has been produced. Pure cultures are now being grown for some extensive cooperative work with spawn manufacturers.

Experiments looking toward an accurate determination of the nutrient needs of the common mushroom have been begun.

The attempt has been made to keep in close touch with mushroom growers and others interested in this work, and to encourage its introduction wherever there is a promise of success. Several cave regions of Missouri have been visited, with a view to ascertaining whether the conditions in these caves are such as to insure successful mushroom culture.

During the coming season numerous plat experiments in the open will be made with *Agaricus campestris* and other edible fungi. The various spawns obtained from wild mushrooms will be tested under various conditions. Special efforts will be made to secure cultures of all the most desirable mushrooms in this section of the country, and much attention will be given to a study of their nutrition and general physiology.

Spawn-making experiments will be continued, having especially in mind the production of spawn of select varieties and the manufacture of a spawn which will be of lighter weight than that now on the market.

## PACIFIC COAST LABORATORY.

The work at the Pacific Coast Laboratory, under the immediate supervision of Mr. N. B. Pierce, has included a number of problems of great interest to that region. The investigations pursued at the Pacific Coast Laboratory have been actively prosecuted along several lines—the treatment of plant diseases by sprays and other artificial means; the production of disease-resistant plants and those of exceptional hardiness; the breeding of pedigreed trees and hardy grafting stocks; the production of new types of fruits by hybridization and selection; and the collection, cultivation, study, and improvement of wild plants obtained from all portions of the world.

WALNUTS.—In the treatment of plant diseases most attention has been given to the prevention of the bacterial disease of walnuts induced by *Pseudomonas juglandis*, a disease which is causing heavy losses to the walnut industry. The work of the year thoroughly demonstrated the accuracy of results obtained with sprays in former experiments, and showed that 50 per cent of the losses sustained through this disease may be prevented by spraying methods. A circular of instruction was issued and walnut growers are taking advantage of the information thus supplied. The saving resulting from this work will be considerable. In addition to the advance gained in the artificial treatment of walnut bacteriosis, much progress has been made during the year in the selection and breeding of resistant types of trees. Records of a large number of badly infected seedling orchards have been kept for two years, showing the susceptibility or immunity of thousands of trees. From this extensive experiment ground there are being selected those trees having desirable fruiting qualities and habits of growth, combined with the highest degree of immunity from disease. When from among these orchards suitable trees are found which prove to be practically immune after several years of exposure to infection, buds will be selected and the variety preserved by propagating the immune type upon suitable stocks. Numerous practically immune trees have already been located.

During the investigation it has been learned that *Juglans regia* is the only species of walnut affected by bacteriosis. Acting upon this observation, extensive walnut-hybridizing work has been in progress for several years, and at present many hundreds of hybrid trees are being grown. These hybridizations represent crosses between most of the known species of walnuts, and it is purposed to continue this work until the desired qualities of fruit and immunity are secured if it is found practicable to thus obtain them by the introduction of resistance from immune species. Owing to the fact that several years are necessary to bring each generation of trees to a fruiting age, these experiments will require many years for completion.

In connection with the breeding of walnuts resistant to disease, an effort is being made to produce by hybridization a walnut of high fruiting qualities and with sufficient hardiness to withstand the low temperature of northern winters. Extensive breeding work has been done along this line between *Juglans regia* and those walnut species having sufficient cold-resistant qualities to grow successfully as far north as the Canadian line. Many trees of this class of hybrids have already been obtained, and in case the productiveness of these trees does not fall below that shown by the parents it is not impossible that a great extension of commercial walnut culture into cold latitudes may result. This work is supported by the views of Professor Sargent, who, from the known hardiness of one parent in each of the hybrids, thinks the work may meet with ultimate success. This work will be pushed along all practicable lines. The root system of the Persian walnut is easily injured and very sensitive to unfavorable soil conditions. It has been learned, however, that the root of a hybrid produced by pollinating *Juglans regia* with *Juglans californica* is exceedingly hardy in unfavorable soil conditions and that the tree shows remarkable vegetative vigor. It has therefore been the work of the laboratory to produce these hybrid roots for grafting stocks. The work was begun in the spring

of 1901, and at present hundreds of these stocks are under cultivation in the gardens preparatory to the budding tests to be made with disease-resistant buds.

A further line of investigation looking to the advantage of the walnut industry is the breeding of pedigreed trees. Thousands of acres of walnut orchards now largely supplying the markets are nearly all of seedling trees grown from nuts of unknown parentage. This practice has resulted in a great diversity in the types of trees and in the size and shape of the nuts placed upon the market. These have always represented disadvantages to the industry. Such facts have led the laboratory to undertake experiments with the object of determining whether nuts of known and selected parentage may be relied upon to give trees of practically uniform habits of growth and fruiting qualities. If it can be shown that such is the case it will be a simple matter to select and breed between the most desirable and hardy trees, and thus to insure seedling orchards of a uniform type of tree and fruiting qualities and each tree possessing a high degree of disease-resisting power. Such a system would revolutionize present methods and would eliminate the apparent necessity for producing budded or grafted trees, which with the walnut is an exceedingly difficult, uncertain, expensive, and in many cases unsatisfactory undertaking.

GRAPES.—Another year has shown no change in the uniform resistance of the vines being tested against the California vine disease. A 400-acre experiment in the Sacramento Valley, which was inaugurated nearly seven years since, is a complete success up to the present date—four and one-half years from the time of grafting on 2-year old roots. At present (July, 1903), the manager of the property where the work is conducted writes that none of the grafted vines has died of the disease which has killed or is killing the remainder of the 3,000-acre vineyard. These are the most encouraging results thus far obtained in our experiments looking to a method of controlling the California vine disease. While it is not well to draw conclusions too hastily, the present results seem to indicate that a practical if not an absolute method of overcoming the disease in the infected districts has been found. Experiments looking to the most severe test of this matter in southern California have already been inaugurated, and like tests are being carefully followed in other infected districts. This cultural method of overcoming one of the most serious and obscure vine diseases known, if it withstands the test of time, as now seems probable, will save to the Pacific coast many millions of dollars, and will result in the maintenance and development of a vast viticultural industry whose very existence has been threatened for many years. The facts upon which these experiments have rested were obtained in the early study of the disease made in 1899 in southern California, and were supported by later observations in other portions of the State. This investigation is being pushed as rapidly as consistent with reliable results, and at present it appears probable that the results will warrant publication within the coming eighteen months, which time will permit of careful observations being made in the summers of 1903 and 1904. In addition to the grafting of resistant varieties as a means of overcoming this disease, plans are already on foot for extensive breeding work with a similar object in view. This work has not progressed sufficiently, however, to warrant discussion at this time.



CHERRIES, ALMONDS, CURRANTS, ETC.—It is a fact well known to residents of warm climates that our cultivated cherries, almonds, currants, gooseberries, and many other fruits and nuts of great value in temperate zones are nonproductive or unsatisfactory in semitropic climates. It is not so generally known, however, that other representatives of the genera *Cerasus*, *Amygdalus*, *Ribes*, etc., to which these valuable plants belong, are native and fully productive in certain semitropic regions. In view of these facts, the Pacific Coast Laboratory has undertaken, through the hybridization of the cold and warm climate species of these and other genera, to produce desirable fruits of the named types, which shall be both acclimated and fruitful in warm climates. While this work is in its early stages, much collecting of needed forms has been accomplished. There now appears every reason to believe that this line of effort may ultimately give to the warmer sections of the United States, and to the world in general, many new semitropic plants of economic importance.

PLANT IMPROVEMENT GARDENS.—During the year gardens have been established in connection with the Pacific Coast Laboratory which are intended especially for the collection, cultivation, breeding, selection, and general improvement of wild plants of such types as it is thought may thus be made more useful to man. The fruits, nuts, berries, flowers, and other useful and ornamental plants under cultivation, or already turned to the needs or pleasure of man, represent but an insignificant minority of those plants capable of such uses. It is therefore with a deep sense of the vastness of the opportunities offered by nature's stores that an effort is being made to bring together some of those plant forms not hitherto brought under the ameliorating influences of cultivation, pruning, breeding, and selection, and to make a call upon the resources of this almost unworked field for plant improvement. As a result of only a few months of effort several wild fruiting and ornamental plants have been secured which are well worthy of a place in our orchards and flower gardens, while the future of this work bids fair to become a most valuable addition to the lines of research undertaken by the Department.

#### PLANS FOR CURRENT WORK.

The technical laboratory work in pathology will be continued along the same lines as in the past. The work on the bacterial disease of plums will be completed, and the investigation of the soft rots of potatoes will be continued. The relation of the sweet-corn disease to field corn will be looked into, and some further work is planned on the sugar-cane disease.

The work on sugar beets will consist of a further study of the diseases of this crop, with attempts to secure strains of beets resistant to curly-top, and also, if possible, to secure a strain producing a single-seeded boll. A study of the effect of fertilizers on the resistance of the beet to disease will be further tested, and special attention will be given to securing a satisfactory spraying apparatus for use in beet culture. We have a sprayer now in course of construction which we believe will meet all the requirements. One of the great problems in beet culture is to secure a prompt germination of the seed. Preliminary experiments have indicated that by methods of treating the seed, quick and satisfactory germination can be secured.

The spraying experiments for the control of cranberry diseases will be pushed forward as rapidly as possible, and the study of the life history of the fungi supposed to cause these diseases will be continued. Some selections of cranberries resistant to disease were made the past season, and these will be tested during the coming year.

The work on the diseases of orchard fruits will be mainly along the line of field demonstrations. Further work will be done on the spraying of peaches and plums, with the hope of finding some means of controlling the peach and plum rot. The new plum disease of the South will also be carefully investigated, and considerable attention will be given to the subject of experimental machinery for orchard work. So-called dust spraying will be compared with the standard methods recommended by the Department.

Further selections and tests of cotton are to be made in the Southwest for the purpose of securing a variety resistant to root-rot, and the life history of the fungus causing this disease will be further studied. The selection and cultivation of resistant Sea Island cottons will be continued for the purpose of securing seed for distribution in cooperation with the Congressional seed distribution. Additional selections and tests of wilt-resistant Upland cottons are planned, and the resistant strains already on hand will be propagated for distribution. The same line of work will be continued in the selection and development of wilt-resistant cowpeas, watermelons, tomatoes, and cabbages. We hope also to make considerable progress in the study of pecan diseases.

The work of the Plant-Breeding Laboratory will be continued on those problems that have not been completed, and certain new lines of research will be inaugurated.

The long-staple Upland cotton hybrids which have been produced will be grown and selected to fix types as rapidly as possible. Other hybrids will be made in the hope of securing further improvements. The straight selection work with long-staple sorts will also be continued. The breeding and adaptation of Egyptian sorts will be extended as rapidly as possible, and tested in new regions in order to determine where this cotton of the best quality can be produced. The valuable strains will be propagated for distribution in the fall of 1903 or 1904, as the development of the work seems to justify. The select new seed imported in 1902 will be used in starting selections in new places. Work in securing strains resistant to the boll weevil and Texas root-rot is promising and should be extended. The production of strains that will mature very early and thus avoid injury by the boll weevil is also a very promising field, and work here should be undertaken.

The investigations in corn to secure strains more productive and richer in oil will be continued, and seed will be secured for distribution as soon as possible. The experiments in the preservation of seed will probably be completed the present season and the results published. Work on the origination of varieties of sweet corn of better quality for canning purposes will be inaugurated.

The promising varieties of citrous fruits and pineapples will be propagated for distribution and the work continued on other hybrids not yet thoroughly tested.

The work in securing hardy winter and more productive oats will be continued as rapidly as possible. In the Northwest the production of smut-resistant sorts with stiff straw will be extended in cooperation

with the State experiment stations and interested farmers. The production of a variety especially adapted for the manufacture of cereal foods will also be given particular attention.

In alkali investigations the breeding of more resistant strains of cotton, alfalfa, barley, and other important crops will form the major part of the work. Experiments in the securing of a cotton more resistant to alkaline conditions and adapted to regions in this country where such conditions prevail will be continued. Further plantings will be made of Turkestan and other imported alkali-resistant alfalfas, and experiments with oats, barleys, and wheats from north African alkali regions will be inaugurated. A feature of the work which it is planned to carry out consists of laboratory experiments in the resistance of various economic plants to the effect of alkali salts.

In the cereal investigations special attention is to be given to the introduction and improvement of hardy winter wheats, especially the Kharkof and Beloglina, and some of the new hybrids. In the Northwest further tests will be made of the Swedish Select, Tobolsk, and Sixty Day oats and of the Hanna barley. Although these varieties introduced by the Department are a great improvement over the local sorts, they can be still further improved by a few years' careful selection. This work will be continued in cooperation with the State experiment stations as far as practicable. The work in the South will be largely the improvement of winter grains, and in the Southwest some more work is to be done on macaroni wheats in order to more perfectly adapt them to that region. The work on this latter crop in the West and Northwest is practically completed and the new industry is on a thoroughly satisfactory basis.

In the nitrogen work all the minor details necessary for the successful distribution of cultures of nitrogen-gathering bacteria for the inoculation of seed or soil are now satisfactorily established. During the coming year large quantities of these cultures will be distributed in various sections of the country. The distribution of the cultures will become a regular branch of the office work and will demand constant and careful attention. The condition of legume work warrants the vigorous investigation of a more important and far-reaching branch of the same subject—namely, the securing of organisms and a practical method for their distribution which will fix nitrogen in soil independently of any particular crop. Organisms of this nature are known scientifically, but have not come into practical consideration. It is believed that by visiting certain laboratories in Europe information and cultures can be obtained which will save a number of years' investigation in this country. Such a trip has been planned, and it is expected with the help of the information gained in this way that some decided results along the line of soil inoculation for all crops may be obtained.

Further tests will be made of our method of preventing algal growth in water supplies. We hope to demonstrate that such growths can be prevented and destroyed at slight expense.

In the investigation of the diseases of forest and shade trees special attention will be paid to the diseases of hard woods in the Northeast, and in the South to the red heart and bluing of pine timber. An investigation carried on in cooperation with the Bureau of Forestry on the preservation of timber and the method of increasing its resistance to decay is to be conducted on a large scale during the present



season. Two experimental plants have been secured for the treatment of timber to determine its resistance to decay as affected by steaming and the use of various preservatives. An experimental plant for the treatment by a new process using the electric current is to be built in cooperation with the Northern Pacific Railway, and we believe that this is a process of great future promise, as it will enable us to treat timber at a small cost without expensive apparatus and will make its use practicable in every small village where an electric-light plant is situated.

The work on the breeding and selection of English walnuts will be pushed along as rapidly as possible during the coming season, and the hybrids on hand will be carefully cared for. It is planned to propagate the most desirable of the grape hybrids and to arrange for their further distribution in the various regions where they may be adapted. A bulletin describing the bacterial disease of the English walnut and its treatment will be completed during the year, and, if possible, also bulletins discussing several other of the more important diseases of crops on the Pacific coast.

#### BOTANICAL INVESTIGATIONS AND EXPERIMENTS.

The Botanical Investigations and Experiments are under the charge of Mr. Frederick V. Coville. The principal work of the year in this branch of the Bureau is set forth below.

#### SEED LABORATORY.

##### SEED-TESTING WORK AND OTHER SEED STUDIES.

During the past year about 3,000 samples of seed have been examined by this laboratory, which is in charge of Mr. Edgar Brown. Practically all of these samples have been tested for vitality and a large number for both mechanical purity and vitality. These samples have been drawn from various sources. Tests have been made for the Congressional seed distribution and for experimental purposes in carrying on special work in seed investigation. It is encouraging to note that a larger number of samples is sent in each year by farmers. Samples of all grass and forage-plant seed imported through the various ports of entry have been forwarded to the Seed Laboratory by the collector of customs. By a study of these samples a knowledge has been gained of the quantity and quality of the seeds imported. The relatively high price of clover and alfalfa seed has had a marked effect on the quality of the seed imported. Several large lots of alfalfa have been received which are absolutely worthless and can only be employed in grading down better seed. A large amount of yellow trefoil (*Medicago lupulina*) seed has been imported, which we have positive information was used in the adulteration of the seed of common red clover. Large quantities of alsike and timothy screenings are brought in from Canada and re-cleaned on this side. The merchantable seed which is cleaned out of this material is poor in quality and carries a large proportion of weed seeds.

There have been brought in from Canada the past year 450,000 pounds of Canada bluegrass. While this seed has a value in certain localities, the chief use to which it is put seems to be the adulteration

of Kentucky bluegrass seed. What seems to be the most effectual way of preventing the importation of the low-grade seeds referred to, as well as those which are used for adulteration, is the placing of a duty which will be practically prohibitive on all seeds which fall into these two classes. An arrangement of this kind would not interfere with traffic in seeds of good quality, except such as are used for purposes of adulteration, and would at the same time protect the United States from the importation of worthless material.

Studies have been made on the development and seed coats of several genera, with a view to finding characters by means of which the seeds of closely related species can be separated where the external characters are not sufficiently distinct.

Local collections of seed have been made and these amplified by collections made for us in various parts of the country. A seed exchange list was issued and a large number of exchanges made with botanic gardens and seed-control stations. In this way material has been collected which, together with the present large herbarium, is available for technical papers on the seeds of various groups. From the seeds collected there have been put up sets of 100 species, which have been distributed to schools. No charge has been made for the seeds or labor of assembling, but the recipients have paid for the trays and vials, which is sufficient to insure their being cared for after they are received.

A series of experiments has been begun to determine the effect on seeds of climatic conditions, cold storage, and burying in the ground. Examinations have been made of the seeds imported by the office of Foreign Seed and Plant Introduction to ascertain the weed seeds which they may contain. In this way the sending out of seeds containing dangerous foreign weeds is avoided. When unknown seeds have been found they have been grown for identification. A compilation has been made of the legal and customary weights per bushel of seeds in the United States. While seeds are nearly all sold by weight, the weight per bushel is valuable in determining quality.

The study of the relative value of common red clover of United States and European origin has been continued in cooperation with nine State experiment stations. The results show that none of the clovers of European origin equals those from the United States in yield. They are, however, much better adapted to the conditions in our extreme Northern States than to those in the southern part of our clover belt. One or two of the foreign samples may have possible value on account of the glabrous character of the plants as contrasted with the hairiness of domestic clovers.

An experiment was begun last fall to determine the effect of maturity on seed corn. Samples were taken at frequent intervals during the ripening season and the seed has been planted this spring. The germination tests made of these samples show that while immature seed germinates remarkably well, its keeping qualities under ordinary conditions are very poor. Work has been done on the commercial production of the seed of the hairy vetch. Two areas are now being grown, one in Ohio and the other in Maryland. The propagation of wild rice, concerning which many inquiries have been received, has been worked out in cooperation with Mr. C. S. Scofield. The results of these investigations, together with suggestions for harvesting and planting, are ready for the press.

## FIBER INVESTIGATIONS.

MANILA.—During the year the fiber investigations, which are in charge of Mr. L. H. Dewey, have been pushed forward with vigor. The high price of manila fiber, resulting from an increased demand, with a comparatively small supply during the past few years, has led to the exportation from the Philippines of much inferior and poorly prepared fiber under brands and marks that were formerly considered a guarantee of better quality. The attention of the Department was called to these unsatisfactory conditions by American manufacturers using large quantities of the fiber. An investigation was made, and a report of the facts which were learned was forwarded to the government officials in Manila. The Philippine government, acting upon this report, has made a very thorough investigation of the manila fiber industry there; and this investigation, carried on under the direction of the insular bureau of agriculture in Manila, has brought out many important facts that heretofore had not been generally known. It has been ascertained that there are several varieties, and at least two distinct species, of the plants from which manila fiber is obtained. Information in regard to the conditions under which these different kinds of plants thrive best, the manner in which they are propagated and cultivated, and the manner in which the fiber is cleaned and prepared in the different provinces will undoubtedly lead to marked improvement along these lines. Furthermore, the action of the government seems likely to lead to some kind of systematic inspection which will prevent the exportation of inferior grades of fiber, unless these grades are packed by themselves in plainly marked bales. A packet of seeds of the manila plant was received by this office last November from Manila, and, in cooperation with the office of Seed and Plant Introduction and Distribution, these have been grown successfully in the greenhouses of the Department. One shipment of the young seedlings has been forwarded to the experiment station at Mayaguez, Porto Rico, and a few of the plants are now growing at that station. The most of them are being kept to secure more hardy stock. They are to be forwarded to Porto Rico and Hawaii. So far as is known, this is the first time that the true manila fiber plant has been successfully grown from seeds in America.

SISAL.—The cultivation of the sisal plant in Hawaii is being continued with increasing success, and during the past year the first commercial shipments of sisal fiber from those islands have been made, the fiber finding a ready market in San Francisco, where it is giving good satisfaction. A few small sisal plants from the Bahamas, sent by the Department to the experiment station at Mayaguez, Porto Rico, a year ago, are thriving, and give promise that the sisal industry may be successfully introduced in that island. While in Tamaulipas, Mexico, early in June, the botanist in charge of fiber plants found in several places, at altitudes ranging from 1,000 to 2,000 feet, a plant being cultivated which was said to be "Tamaulipas henequen." This appeared to be in nearly every respect like the Yucatan henequen, the true sisal plant, but it is more hardy than the plants grown in Yucatan, and will endure a temperature occasionally down to freezing. It seems probable that plants from Tamaulipas might be successfully introduced into cultivation in regions where the climate is



too severe for the successful cultivation of the Yucatan plants. The fiber is of the same character as the Yucatan henequen.

**ISTLE.**—An investigation has been made in regard to the plants in Mexico producing the fiber commonly known in our markets as istle. This fiber, which heretofore has been chiefly used in the manufacture of brushes, is now being imported into the United States in large quantities for use in the manufacture of cordage. It is strong, and though shorter than the best sisal, it can be made with improved machinery into a very good grade of cordage. Just what plants were being used for the production of this fiber was heretofore not definitely known. The three grades of the fiber on the market are known as "Palma istle," "Tula istle," and "Jaumave istle." Palma istle is obtained almost exclusively from the cogollos or inner leaf clusters of the palma samandoca (*Samuela carnerosana*), a plant of the yucca family, and from the leaves of the zamandoque (*Hesperaloe funifera*). The leaves are steamed before cleaning the fiber, which gives it a brownish color. Tula istle is obtained from the lechuguilla (*Agave lecheguilla*). During the past year another plant, espadin (*Agave striata*), has also come into use for the production of a cheap grade of istle fiber. Jaumave istle is produced exclusively from a taller growing variety of lechuguilla. The plants in the rich Jaumave Valley attain a height of from 20 to 40 inches, while those in other parts of Mexico are rarely more than 25 inches high.

All of these plants grow wild in profusion, and at the present time no attention is given to propagating or cultivating them. The lechuguilla belongs to the same species as that which grows abundantly in western Texas, and it seems probable that with the use of machinery, which is now beginning to be introduced into southern Chihuahua, the Texas plants may be profitably utilized for fiber production.

**FLAX.**—In cooperation with the office of Seed and Plant Introduction and Distribution, a quantity of flax seed representing the best varieties from Riga, Russia, and from Holland and Belgium, has been imported, and these seeds were sown at intervals during the past spring at Salem, Oreg. Weather conditions have been very unfavorable to the production of flax this season, but the experiments have already demonstrated that imported seed produces plants of a marked superiority for fiber production over those grown from Oregon seed.

**HEMP.**—An experiment is being conducted in cooperation with the experiment station at Logan, Utah, to determine whether hemp can be successfully cultivated at that high altitude under irrigation.

#### TROPICAL AGRICULTURE.

This work is in charge of Mr. O. F. Cook, and consists in the main of field investigations and experiments. During the year publications on the mango, the economic plants of the island of Guam, and the culture of the Central American rubber tree have been completed, and others are nearly ready. Field investigations have been directed principally toward coffee, rubber, cacao, and bananas, the principal articles of import from tropical countries. It has been found that by proper methods of culture coffee can be produced at a profit in localities where labor and transportation are more expensive than in Porto

Rico; and that such methods are adapted to districts in Porto Rico and elsewhere that are now considered too dry for coffee. New varieties, quite distinct from the normal or Arabian type of coffees, were also found to appear in plantations spontaneously and without selection, and to propagate true from seed. These abrupt variations or mutations are, however, degenerative in character and less productive than the parent stock. It is important to recognize such trees and remove them from the plantation, and to select seed only from the productive trees of the normal type. An examination of native Central American varieties of cacao reveals important differences in quality, productiveness, agricultural requirements, and resistance to disease, out of all proportion to external characters. These differences promise a wider extension of cacao growing in all our tropical islands. Two species of the Central American rubber tree were found to be cultivated in Costa Rica. One of them is new to science, and both are different from species studied last year in southern Mexico. The discovery that several distinct species are being cultivated instead of one explains some of the very contradictory opinions regarding the methods and profits of rubber culture in Mexico and Central America, since the differences are not merely external, but affect the cultural requirements and quality. Evidence was secured to confirm the belief that a continuously humid climate commonly considered necessary for rubber culture is in reality disadvantageous.

#### DRUG AND MEDICINAL PLANT INVESTIGATIONS.

The investigations of drug and medicinal plants are in charge of Dr. R. H. True, and experiments in this work were carried on in cooperation with the State agricultural experiment stations at Puyallup, Wash., and at Burlington, Vt.; also with Mr. Albert Ovendon, of Madison, Wis., and Mr. George H. Woodhull, of Dover, Mass. Experiments were also begun on the Potomac Flats and at the Arlington Farm. Owing to the failure, from one cause or another, of several kinds of plants under test at these places, these preliminary experiments were of less value than would otherwise have been the case. In general, it appears clear that in the northern or north-central parts of the country several important kinds of drug plants will grow well. Among the number may be mentioned digitalis, sage, summer savory, henbane, valerian, ginseng, golden seal, and stramonium. In the more southerly part of the country, in the moister eastern part, many of these will probably do well when properly cultivated. In the case of ginseng, golden seal, and other plants characteristically forest inhabitants, special methods of culture, including artificial shade, seem to be necessary. The opium poppy develops excellently in the more northern stations, and under proper soil conditions would doubtless thrive as far south as the Carolinas. The best capsules seen were from the station at Puyallup, Wash.

In order to get some understanding of the process involved in handling some of these products in larger quantity, an experiment was carried on at Dover, Mass., in cooperation with Mr. George H. Woodhull, in which about one-half acre of drug plants was cultivated and harvested. The plants studied were chiefly those producing leaf drugs and consisted in the main of *Datura stramonium*. This species formed the larger part of the planting, and was chosen because it could be

considered typical of a number of other leaf drugs. The plants were cultivated by Mr. Woodhull under directions from the Department, and harvested and marketed by him, also under the direction of the Department agents. The results of the experiment were important. The price at which labor could be obtained, the value of the land and the length of the vegetative season all proved important factors, and the experiment tended to show that in the situation concerned labor was too expensive, the value of land in use too great, and the length of the growing season too short to yield favorable results with most of the drug plants of the types tested. This seemed to indicate that the yield which might be expected from plants of the types here concerned, and the price which they could command in the market, are both too small to prove remunerative near Boston. While this is a good market, the conditions for producing many of these articles are not favorable. The conclusion follows that more favorable conditions are likely to be found farther south, especially in the States where cheap labor, cheap land, and a long growing season can be obtained.

The process of curing the leaf drugs was studied at Dover in a rough way. Natural heat, both in the sun and in the shade, was used; also artificial heat. The general outcome of this part of the experiment seemed to indicate that the methods of curing leaf drugs now popularly held to be not the best, although the leaf obtained by drying in accordance with these customs in the shade, without the application of artificial heat, when marketed, was rated as a prime article and commanded very favorable prices. Still a much superior article was obtained by the application of artificial heat at a much higher temperature than is usually supposed to be favorable to the proper curing of leaf drugs. The product obtained by the use of artificial heat of a rather high degree was very bright in color and gave a more favorable assay for the active principle than any of the other samples. This phase of the experiment will be followed up more carefully under more favorable conditions during the coming season.

The experiment on the Potomac Flats, while limited in extent, seemed to give clear indications of the possibility of growing several kinds of valuable drug plants in this country. Licorice is of special interest in this connection on account of the large importation of this product, about \$2,000,000 annually being spent for licorice root and its products. The domestication of wild drug plants was begun on a small scale with golden seal, which has done well and has produced a good crop of seed during the year. Owing to the price at present commanded by this root and the rapid disappearance of the plant from the forests, its successful domestication is extremely desirable. This is heightened by the fact that there is a steady and increasing exportation of this drug to European markets, indicating an enlarged demand if the product can be furnished. In connection with the cultivation at Washington of valuable wild drug plants in addition to the golden seal, small cultures of *Spigelia marylandica* and of *Aristolochia serpentaria* were made.

With the beginning of the present season the experimental work for the year was arranged in view of the results of the experiments of the foregoing season, and it seemed best to concentrate our efforts at a few points and on larger areas than were made use of during the former season. The excellent results obtained in connection with the cooperative experiments of the Vermont experiment station, at Bur-



lington, seemed to indicate that this location would be a favorable point for the work. A southern station was obtained on the plantation of Mr. A. P. Borden, of Pierce, Wharton County, Tex., where ample facilities will be granted. At the Vermont station small areas of about a dozen of the most promising plants have been established, and the present outlook for the work at that point is very favorable.

#### INVESTIGATIONS OF POISONOUS PLANTS.

Studies on poisonous plants have been carried on, as in previous years, under the direction of Dr. V. K. Chesnut. Much of Dr. Chesnut's time during the year has been devoted to answering inquiries relating to poisonous plants, especially with reference to preventing their injurious effects. The principal field work during the year consisted in the investigation of stock poisoning in Montana from the effect of camass and lupine. It has been found that where such plants as carrots and mustard are fed in connection with the poisonous camass the injuries from the latter are very much lessened. Contrary to the usually expressed opinion, animals poisoned with camass should be allowed to drink freely of water. A number of other cases of injury from poisonous plants were investigated and methods of treatment provided which have been highly satisfactory.

#### GRAIN GRADE INVESTIGATIONS.

The work of these investigations has been carried on under the direction of Mr. C. S. Scofield, and, for the most part, was a continuation of that of the previous year. The principal line of work consisted in the study of the various systems of grain inspection and grading found in the different large grain centers of this country, with a view to learning, as far as possible, the causes for the unsatisfactory work of the various inspection systems, and the causes and methods of prevention of the rapid deterioration of grain in transit and in storage. The results so far achieved indicate that the chief cause of incorrect and nonuniform grading of grain is the lack of knowledge on the part of grain inspectors of the essential elements to be considered in grading grain and insufficient opportunities for these men to learn what these elements are and how to measure them. The remedy for this condition of affairs may be had by requiring a more intimate knowledge of the business as a qualification for work, and by furnishing inspectors with better apparatus for their work. The work for the past year has been confined largely to corn, our most important cereal. The essential elements to be considered in grading corn have been learned and an apparatus for measuring them has been developed. The definite rules necessary to secure more uniform and accurate grading of corn have been suggested to the trade, and one actual trial of the apparatus and the improved methods of work has been made. The results of this trial are highly satisfactory and show that it is possible to grade commercial corn uniformly and accurately on the basis of its essential qualities.

The investigations regarding the deterioration of grain in storage and in transit have also been, so far, confined to corn and have been carried far enough to show that this deterioration is caused almost exclusively by excessive moisture. This deterioration can be wholly

prevented by properly drying the grain before any damage has occurred. Large commercial corn driers are now used to some extent, and their use is rapidly becoming more general. So far as can be determined at present, this drying of corn, if done wisely, does not injure the grain for any purpose. Some dissatisfaction now found with commercially dried corn is caused by improper methods of drying, by the use of too high a degree of heat for too short a time, and also because corn, after having been damaged by mold, is sometimes dried and cleaned, but by retaining the moldy smell is always inferior.

#### CURRENT WORK.

The studies of seed for mechanical purity and germination will be continued for actual purchasers, and an attempt will be made to bring to the attention of farmers the importance of the quality of the seed sown and the way in which tests can be obtained. This will be done through the Department publications, the agricultural press, and possibly by means of farmers' institutes. Local collections of seed will be made and outside collectors will be engaged to work in various localities. There is a constant demand from agricultural colleges and experimental stations, as well as from seedsmen and others, for typical sets of seeds of weeds and other plants. Such sets will be prepared and distributed where it is practicable to do so. It is planned to continue the technical studies of seeds of representative genera of economic plants. Cooperative work will be carried on during the year with the Bureau of Forestry on the study of seeds of pines. Collections will be made during the present summer of the economic species, and experiments made to determine the best way of storing and testing for germination, as well as growing in the nursery. Extensive work has been begun and will be carried on during the present and succeeding years to determine the various causes which affect the vitality of seeds. Experiments will be made to determine the best conditions of climate, soil, and locality for the production of millet, teosinte, bent grass, and Bermuda grass seed. The work now being done in this connection with hairy vetch will be continued until definite results are obtained as to the production of seed on a commercial basis. This work on seed production is highly important, and will be pushed as rapidly as the means at hand will permit. Studies will be made on the harvesting, curing, and handling of forage-crop and other seeds, and cooperative work will be begun and carried on to determine the quality of grass and forage-plant seeds offered for sale in certain States. This work will be carried on in connection with the experiment stations, the object being to point out methods of improving the quality of seeds sold throughout certain typical regions.

In the work on fiber plants the cooperative experiments begun during the past spring in the cultivation of hemp and flax will be continued. Investigations in regard to the production of sisal and manila fibers, and new work on the classification of varieties of cotton, and experiments in the cultivation of mat rushes will be continued. An experiment in the cultivation of hemp under irrigation was begun this past spring in cooperation with the experiment station at Logan, Utah. The crop is now growing well, and it will be harvested, retted, and broken to determine whether a good grade of fiber can be produced under the conditions there. All of the seed used for the production of fiber hemp in this country is now raised in a limited area

in Kentucky. The supply is inadequate and prices are often unreasonably high. Experiments will be undertaken in the Mississippi Valley and in California in the production of hemp seed. Nearly all of the flax fiber used for textile purposes in this country is imported. Experiments will be continued in the cultivation of improved varieties of fiber flax, and investigations will be carried on in regard to methods of preparing the fiber.

The most promising cordage fiber plant for introduction into Porto Rico and Hawaii is the sisal. Investigations begun in the Bahamas in 1892 will be carried on in Yucatan and Tamaulipas, Mexico, with a view to securing stocks of the best sisal plants and information in regard to handling them. The manila fiber plant, which produces the best cordage fiber known in commerce, is cultivated successfully only in a limited area in the Philippine Islands. Experiments already begun will be continued to determine whether these plants can be grown successfully in Hawaii and Porto Rico. Work on the study of varieties of cotton will be begun next spring, to be continued during the following autumn, with a view to a systematic classification of the varieties of cotton which may serve as a basis for all investigations in this most important crop.

In the work on tropical agriculture, investigations are under way having for their object the discovery of improved methods in the production of high-grade coffee in parts of Porto Rico now considered too dry for coffee; the south side of Porto Rico will be studied with a view to selecting the best locations for experiments on these lines; also the conditions and methods under which the high-priced Blue Mountain coffee of Jamaica is produced. Laboratory experiments are planned to ascertain uniform and reliable methods by which the essential qualities and commercial grades of coffee may be determined. Such a method is necessary in order to learn the effect of cultural conditions and methods upon the quality of coffee, and also to prevent the substitution of low-grade for high-grade coffees, the production of high-grade coffees being the only way to avoid the competition of Brazil.

It is planned to continue the study of the species and varieties of the Central American rubber tree in eastern Mexico and in Colombia. Instead of a single kind of rubber tree widely distributed in Central America, the existence of several quite different species has been demonstrated. Which of these is likely to be most suitable for introduction into Porto Rico and the Philippines remains to be determined. Results of experiments already tried with different rubber trees in Trinidad, Jamaica, and Cuba will also be studied, and the possibility of cultivating Ceara rubber in Florida will be investigated.

Cacao culture is practicable in all our insular possessions. Yield and quality depend very largely upon the variety planted and the methods of preparation for market. It is desired to continue the study of cacao varieties and methods in Central and South America, and especially in the island of Trinidad, where the subject has received the most intelligent investigation. It is also proposed to study the requirements of the trade and to determine, if possible, by laboratory experiments, what are essential qualities of the high-priced beans. Considerable material for a publication on the cultivation and uses of the cocoanut has been collected, and additional observation in Jamaica and Trinidad should make possible the completion of this work.



In the work on drug and medicinal plants it is planned during the coming fiscal year to follow up the work on the opium poppy and to prosecute actively the search for methods of utilizing either the dried herb or extracts from it as a possible source for morphine. In view of the large importation of opium into the country, it is also thought desirable to attempt the making of opium on a small scale in connection with the Texas experiment, labor there being abundant and cheap.

The continuation of work in connection with the domestication of wild drug plants, chiefly at Washington, seems very desirable, especially the cultivation of golden seal and ginseng under artificial shade in quantities large enough to yield a considerable product. The further cultivation of established drug plants, such as digitalis, wormwood, aconite, belladonna, and many others on a much larger scale than is at present possible, seems likewise desirable. In each case a sufficient area should be planted with each article to give a product ample to enable us to isolate active principles in considerable quantity. The Texas experiment is not limited by the amount of land available, and the plans for the coming year include the cultivation of several acres in the hope of obtaining a crop for harvesting and marketing. The primary object in this experiment is to demonstrate the possibility of growing the plants here concerned on a commercially profitable basis. In order to do this, of course, an area of considerable extent is necessary to arrive at any satisfactory conclusion. This is clear when one considers the cost of handling and marketing small quantities in comparison with the cost necessary to handle and market considerably increased quantities. The expense of these processes does not increase in proportion to the increase of the product. The plans, therefore, for the Texas experiment include essentially an increase in the area included in the experiment, with a corresponding increase in the crop handled and marketed.

In view of the fact that there is a considerable crop of crude drugs produced in hot, arid regions of the earth which are at present made use of in large quantities, and in view of the further fact that we have in the United States vast areas of dry, arid country which seem to be seeking some agricultural use, it would be very desirable to establish in the Southwest, and perhaps southern California, Arizona, or New Mexico, a station for the study of this class of drug plants and products. Gum arabic, gum tragacanth, senna, colocynth, and others are at present imported from various arid parts of the world, and since the total market value for products from this type of country is a considerable sum, it would seem worth while to attempt the introduction and cultivation of these plants in parts of the Southwest.

In connection with the laboratory at Washington, special emphasis is to be laid upon the fundamental process in making good drugs, namely, the curing of the fresh material. This involves processes of great complexity and of great technical importance, since the price of a drug is to a large degree determined by the correctness of the methods of curing employed.

The formation of active principles making the products valuable will also be studied, with the hope that as the conditions of formation are better understood it may be possible to so influence these conditions as to give an increased production of the active principle. This phase of the work must stand in close connection with the field work,

and will be followed up in connection with the field experiments on the Arlington Farm and on the Potomac Flats.

The current work on the study of poisonous plants includes: (1) A continuation and extension of the office work and investigations of miscellaneous cases of poisoning as have been carried on in recent years; (2) the installation of two pharmacological laboratories; (3) field work on the various poisonous plants of Utah, Wyoming, Montana, Idaho, Oregon, and South Dakota; (4) field and laboratory work, especially with a view to testing the permanganate and diuretic treatment for lupine poisoning; (5) the preparation of a report on lupine poisoning; (6) field and laboratory work to determine the exact pathological conditions characteristic of loco-weed poisoning in the Northwest; (7) field and laboratory work during the spring of 1904 to complete data on *Zygadenus* poisoning; (8) field work on the so-called "bighead" disease of sheep in Utah, Idaho, and Oregon; and, (9) laboratory investigation of various poisonous and medicinal plants of special economic importance to agriculture.

The grain grade investigations for the current year will consist largely in working with the principal grain inspection departments of the United States in endeavoring to establish more uniform and definite rules for grades, and to secure the establishment in these inspection departments of apparatus sufficient to grade grain more accurately and to educate deputy inspectors in its use. In connection with this there will also be carried on some work looking to the classification and description of the standard varieties of American cereals.

It is proposed during the year to considerably enlarge the field work of this office in connection with the improvement of grain inspection systems, to carry on in the offices of the various grain inspectors demonstrations of the improved methods of inspecting and grading grain, to secure improvement of the rules governing grades of grain, and to investigate the effects of artificially drying grain in relation to the subsequent manufacture of it.

#### GRASS AND FORAGE PLANT INVESTIGATIONS.

The important work on Grass and Forage Plant Investigations conducted during the year is set forth by Prof. W. J. Spillman, who is in charge.

#### LEGUMINOUS CROPS.

The value of leguminous crops as a source of protein in feed stuffs and of nitrogen in the soil receives increased recognition each succeeding year. There are three important legumes in this country, namely, clover in the North, cowpeas in the South, and alfalfa in the West. Clover especially has played an important role in the development of American agriculture. According to the recent census, upward of 4,000,000 acres of pure clover hay were produced in this country in 1899, and clover formed a leading constituent of the 31,000,000 acres of hay from "other tame grasses." The increasing difficulty of securing a stand of clover in recent years has created an unusual interest in other leguminous crops as a possible substitute for clover. Attention was first turned to the cowpea, and varieties were secured that extended the limits of this crop to the northern tier of States. But the difficulty of harvesting and curing the hay prevented the cowpea from

gaining much prominence in the clover section. More recently attention has been turned to alfalfa with most gratifying results.

**ALFALFA.**—In order to test the adaptability of alfalfa to the climatic and soil conditions prevailing in those parts of the country where it is little known, this office during the past year selected five States in which from 5 to 25 plats of alfalfa 1 acre in extent were sown on various types of soil. The results of this work show conclusively that alfalfa is adapted to a very wide range of climatic conditions. It flourishes in Wisconsin and the southern New England States, and in the States bordering on the Gulf of Mexico. It also shows itself adapted to wide variations of rainfall, growing luxuriantly in New York and Georgia, and producing fair crops on the ninety-ninth meridian without irrigation. It has been demonstrated that it is adapted to all classes of soils except heavy clays and those that are low and wet. In the Northern States three crops of alfalfa hay are cut in a season, and in the South four or five. There are still some difficulties in curing the hay, particularly in wet seasons. The feasibility of making silage of those cuttings that come during wet periods will be tried in the near future.

**COWPEAS.**—Cowpeas have long been known in the South, and the great value of this crop in the cotton-growing sections is gaining general recognition. Largely increased areas were grown last year. This office has collected all the known varieties of this valuable crop, and is studying their characteristics with a view to ascertaining their adaptability to different climatic conditions and their value for the production of hay and seed. While cowpeas are very generally grown in the South, comparatively little hay is made from them because of the difficulty of curing the vines. We are studying the various methods used by farmers in curing this kind of hay, and have found several successful methods in use by individual farmers. Comparative tests of these methods will be made during the present season. This work is under the supervision of Mr. C. R. Ball.

**SOY BEANS.**—This crop possesses two marked advantages over the cowpea in most parts of the country. Its yield of seed is larger, and, on account of its upright habit of growth, it is easier to harvest. Many farmers harvest soy-bean hay with the twine binder, the crop being exceedingly easy to handle in this manner. The varieties of soy bean offered by seedsmen in this country vary from small bunch beans, growing scarcely a foot high, to tall forms attaining a height of 5 or 6 feet. Heretofore no adequate study of these varieties has been made, a fact which accounts for the lack of recognition of this crop on the part of farmers. During the past year Mr. W. M. Pollock, of this office, grew all the varieties of soy beans obtainable in this country. These varieties will be further tested this season, and it is hoped that we may be in position at the end of the present season to publish information concerning them that will enable farmers to secure varieties adapted to their needs.

**NEW LEGUMES.**—Several new leguminous crops are under observation that are very promising for different parts of the country. As soon as their merits have been determined and an available supply of seed produced they will be distributed in those sections where they are most needed.



## HAY FROM WILD GRASSES.

One-fourth of the hay crop of this country is cut from wild grasses. The areas from which this wild hay is obtained are of two classes, namely, the prairies of the West and the swamp lands located principally in the North Central States but found in smaller areas all over the country. Strangely enough, none of the grasses that now constitute the wild hay crop of the country has ever been brought into cultivation, if we except some unimportant areas of timothy, reedtop, and barnyard grass that grow in a wild or semiwild state. Agents of the Department are now engaged in the study of these important wild grasses with a view of determining the characteristics of the most important species. Particular attention is being given to the seed habits of these grasses in order that seed of the most prominent varieties may be made available on the markets. The value of wild hay from different sources, as compared with standard tame hays, is also receiving attention.

In many parts of the country large tracts of extremely fertile land are rendered useless by annual overflows that preclude the possibility of growing ordinary crops. The most promising swamp grasses are being tested on lands of this character in the hope that varieties may be found that will produce hay on these overflowed lands. It is yet too early to predict the results of these investigations, but the fact that many thousands of acres of such lands already produce wild hay of fair quality indicates that much worthless land may be made productive as soon as we are able to obtain seed of the best swamp grasses in commercial quantities.

## SOIL AND SAND BINDERS.

During the past year particular attention has been given to vegetation adapted to holding embankments and to methods of controlling drifting sand, both in this country and in Europe. Prof. A. S. Hitchcock, of this office, visited during the year all the more important drift-sand areas of Western Europe for the purpose of studying methods for holding drifting sand in place which have been in successful practice in those regions for more than a century. The results of this study are now in process of preparation for publication in bulletin form. Observations made in Europe indicate that practically all the sand wastes of this country can be redeemed by proper management, and work of this character has been inaugurated by the Department in California, Oregon, and Michigan, and, in cooperation with the Light-House Service, at several points on the Atlantic coast.

## RANGE INVESTIGATIONS.

During the past year Dr. David Griffiths, of this office, made a careful study of the range conditions of eastern Washington, eastern Oregon, northeastern California, and northwestern Nevada. The results of this study have been published as Bulletin No. 38 of this Bureau. They indicate that the ranges in the section covered have been badly overstocked in recent years and that, in consequence, the more valuable native grasses have given place to useless weeds. Better systems of range management than those now in vogue are indicated. Similar studies are now in progress on the ranges of southern California,

Arizona, and New Mexico. In this latter area large tracts of range lands are under private control, and the owners have cooperated with the Department in this study in such manner as greatly to facilitate the work. We have been able to offer many suggestions to stockmen in the management of their ranges, and these suggestions have been acted upon with most gratifying results.

In order to study more carefully the best methods of range management with conditions completely under the control of officers of the Department, an area of 58 square miles, located on the Santa Rita Forest Reserve in Arizona, has been fenced by the Department, with the consent and cooperation of the Department of the Interior. This fenced area is under careful observation and experiment. In this work the Department is receiving the hearty cooperation of the Arizona experiment station and of local stockmen. Particular mention should be made of the valuable service of Mr. W. B. McCleary in fencing this area.

Important work has been conducted on the ranges of eastern Washington during the year in cooperation with the Washington State experiment station and Messrs. Babcock and Benson. The latter have kindly turned over to the Department a quarter section of their best summer range, all under fence. Many tracts of this area have been seeded down to grasses during the year, and it has been demonstrated that with proper management much of the depleted range land can be brought back to a condition of productiveness.

#### UTILIZATION OF NATIVE FORAGE PLANTS.

In many parts of the country, particularly in the arid and semiarid portions of the West, several native wild plants are extensively utilized by stockmen as winter feed for stock, in addition to a large number of such plants which constitute the summer feed on the ranges. Several plants of both these classes possess qualities that render them worthy of artificial propagation, even on cultivated land. The following may be mentioned as examples: Of the species of grass that furnish the 15,000,000 acres of wild hay in this country annually one of the most important is blue stem (*Agropyron occidentale* Scribn.). It is found in extensive areas in lowlands and in mountain meadows at high altitudes in most of the arid region. In quality of the hay it produces, stockmen credit this grass with being superior to most of the cultivated grasses. In southeastern Colorado hay made from it sells for 50 per cent more per ton than alfalfa. The Department is studying the habits of this grass with a view to making seed of it available on the markets. The grass is also being grown and tested as a hay-producing crop.

The well-known buffalo grass of the eastern plains region is known to be one of the most nutritious grasses in this country. In the recent past much of the area formerly covered by it has been denuded by overstocking. Unfortunately, buffalo grass produces only small amounts of seed, and these are found on trailing stems from which it is impossible to harvest them at a reasonable cost. It is therefore necessary to propagate it from pieces of sod. That this can readily be done has been demonstrated. Investigations are now in progress with a view to working out the details of the best methods of establishing a sod in this manner,

On limited areas, particularly of overflowed or marshy lands in the arid or semiarid regions, reed canary grass (*Phalaris arundinacea*) furnishes remarkably large yields of highly palatable hay. Even on the ordinary arable lands of the Eastern States this grass, when once established, yields large crops of hay. Unfortunately, its seed habits are such as to render it impracticable to propagate reed canary grass artificially. The seed falls as soon as it is ripe, and if harvested before it is fully mature is exceedingly unreliable. An effort is being made to find varieties of the plant that have better seed habits. Samples of seed from many places have been secured and planted in the grass garden on the Department grounds. There is sufficient diversity in the various forms secured to justify the hope that important results may be obtained from their study.

During the past season several wild plants have spread rapidly over the ranges of western Texas, and added greatly to the supply of feed on the ranges. Among the most important of these are two species of plantain (*Plantago wrightiana* and *P. virginica*), locally known as tallow weed. Stockmen report that these species are much relished by stock and that cattle fatten rapidly while grazing them. Investigations are in progress with a view to making this seed available on the markets.

It has long been the practice of stockmen in the arid regions to tide over unusually severe and prolonged winter seasons by feeding their cattle on cactus, after scorching the stems to remove the spines with which they are covered. It has recently been ascertained that cactus spines lose their rigidity entirely and become perfectly harmless when they become wet. One enthusiastic stockman reports that boiled cactus fed with grain is the equal of alfalfa hay. Having undertaken to carry his starving cattle through the winter on such a ration of grain and cooked cactus stems, he was able to sell them for beef in ninety days. In another section of the country cactus is fed extensively, the only preparation being to run it through a specially constructed feed cutter. The juice from the mangled stems renders the spines absolutely harmless. Plans are in course of preparation to test these points during the coming winter.

#### CASSAVA AS A FORAGE CROP.

A detailed study of this important crop as it occurs along the Gulf coast was made during the year by Prof. S. M. Tracy, of this Department. The results of this study have been published as Farmers' Bulletin No. 167. It was ascertained that cassava is particularly adapted to sandy soils within a hundred miles of the Gulf coast, and that it furnishes an abundance of highly nutritious and palatable feed for cattle and hogs. The chief difficulties in its cultivation were ascertained to be the keeping of the seed canes over winter and securing a complete stand in the field. Methods of overcoming these difficulties were found in successful practice on a few farms. Arrangements have been made to test these methods during the coming season. Through the cooperation of the office of Seed and Plant Introduction and Distribution, seventeen new varieties of this crop have been obtained from Jamaica. Some of these are very promising. The best will be introduced in the cassava region as soon as they have been thoroughly tested. The highly carbonaceous character of the



cassava root renders it unusually important in a region where the usual feed stuffs are much too rich in protein.

#### JOHNSON GRASS.

More detailed study has been made of the distribution of Johnson grass and its relation to agriculture in the Southern States. It is found quite commonly in all the Gulf States and the Carolinas, though there are many areas of considerable size free from it in all these States. It is quite generally regarded as a serious pest; in fact, almost universally so. While Johnson grass has an extensive system of rootstocks, it spreads mostly from seed. Even when cut for hay it is usually allowed to ripen a portion of its seed, and it thus is scattered wherever the hay is fed. On most farms where it has gained a foothold it is regarded as an evil that can not be gotten rid of, and hence little effort is made to eradicate it. Careful experiments conducted by the Department during the past year indicate that the grass may be controlled without undue expense, and that at least two excellent crops, one of winter grain, and one of corn or other cultivated crop, may be grown each year on land badly infested. That the grass can be completely eradicated without enormous outlay has been demonstrated. Much of the trouble with this grass is due to the implements used in tilling the soil. With better plowing and thorough and deep harrowing, followed by persistent cutting back before the grass is 6 inches high, this pest may be completely destroyed. Johnson grass is particularly pernicious on tertiary soils. This seems to be due largely to the difficulty of using the ordinary turning plows on these soils. Plows will not scour in them, except when the soil is very dry; hence the plowing done is imperfect and only encourages the grass. The disk plow is undoubtedly best on this class of soils, and should be used on such lands on farms infested with Johnson grass. Series of experiments in the eradication of Johnson grass are now being conducted in two States with highly satisfactory results.

#### MISCELLANEOUS INVESTIGATIONS AND EXPERIMENTS.

Investigations have been conducted at the Arlington Farm by the office of the Agrostologist during the past season as follows: By Mr. C. R. Ball—tests of cowpeas, sorghums, pearl millets, phaseolus mungo, and silage crops.

##### COWPEAS.

The work with cowpeas comprises tests of varieties; of early, medium, late, and very late plantings of the same seed; of the results of planting seeds from early, late, medium, and late pickings from the same plants last season; of hay production and methods of handling hay.

**VARIETAL TESTS.**—About 60 different lots of seed, representing some 40 so-called varieties, have been planted in single, or sometimes double, parallel rows for investigation of their comparative growth, yield, earliness, hardness, etc. These varieties have been separated largely on seed characters into about 7 groups, and all the varieties representing a single group have been planted in a body.

**EARLY, MEDIUM, AND LATE PLANTINGS.**—It is a well-known fact that the habit of the vine, the quantity of the fruit, and time of maturity in the different varieties of cowpeas may be very greatly influenced by

attention to the time of planting, character of soil, etc. With this end in view, 9 well-marked varieties were selected, the seed of each to be planted at three or four different dates, with intervals of ten to fifteen days, according to weather conditions. Only the first three plantings have been made to date.

PLANTING SEEDS FROM EARLY, MEDIUM, AND LATE PICKINGS.—Seven varieties were selected for this experiment, and seeds which had been saved and thrashed separately from different pickings last season have all been planted on the same date to determine the effect of early or late maturity on the next year's crop.

SELECTION.—By taking a quantity of seed of a variety like the Whippoorwill or Clay, in which the color marking varies considerably, it is possible to separate from three to five clearly distinct color forms. This has been done for 2 varieties, and the different forms planted separately to determine whether they will reproduce true to type, and whether the different forms indicate any difference in habit, time of maturity, etc.

HAY PRODUCTION FROM DIFFERENT VARIETIES, AND METHODS OF HANDLING HAY.—For this purpose half a dozen of the best-known varieties have been planted in areas varying from one-half acre to over an acre in extent, with the intention of testing not only the comparative yield from the different varieties, but also various methods of curing the resulting hay. Cooperative work with this same end in view is being carried on on the farms of Maj. R. S. Lacey and Mr. R. A. Phillips, near Ballston, Va., and also with Mr. W. M. Pollock, of Lorton, Va., seed of cowpeas having been furnished these gentlemen on condition that they plant and cure the hay under the direction of this office.

Tests of a large number of these varieties are being made in cooperation with experiment stations in several States throughout the Eastern and Central United States.

#### SORGHUMS.

About 140 lots of seed, representing native and foreign sorghums, both saccharine and nonsaccharine, obtained through seedsmen, experiment station officers both at home and abroad, and the consular force of the State Department, have been planted for this season's trials. The small quantity which it has been possible to secure in many cases has necessitated, for the most part, single rows, 8 rods long, for each lot of seed. This is a continuation and amplification of the work of last year, and is being done with the double object of determining the actual horticultural status of the numerous varieties of these sorghums, and also their comparative value for fodder and seed production, so far as that may be determined on so small a scale. Similar tests of a large number of these varieties are being conducted in cooperation with the experiment stations at Knoxville, Tenn., and Baton Rouge, La.

#### PEARL MILLETS.

Sixteen different varieties of *Pennisetum spicatum*, known variously as pearl millet, pencilaria, and Mand's wonder forage plant, are being grown to determine any differences that there may be between these different lots.

## PHASEOLUS MUNGO.

The gram, or green gram, as it is called, is remarkable for the variation in color and shape of the seeds, and for this reason 26 rows have been planted with seeds selected for their variations in color and shape, with the intention of ascertaining whether they reproduce true to the parent seed, and whether these variations indicate any valuable differences in the plants which bear them. This plant is being studied as a possible substitute for the soy bean and the cowpea.

## SILAGE CROPS.

It is planned to build a silo on the Arlington Farm during the present season, and it will therefore be possible to grow various silage crops with assurance that they will be carefully handled in making the silage. For this purpose there has been approximately 1 acre each sown in pearl millet, teosinte, early amber sorghum, and cowpeas to test their value for silage purposes in this section.

SOY BEANS.—As stated elsewhere in this report, this crop is one which promises to be of unusual value as a leguminous crop in this country. The principal difficulty in its introduction heretofore has been a lack of knowledge concerning its varieties. We have obtained seed of 70 supposed varieties, and are growing them for the purpose of securing a proper classification, of ascertaining whether or not the names used by seedsmen are uniform for the same variety, and of bringing about uniformity in nomenclature for the several varieties. Cultural experiments by Mr. W. M. Pollock are in progress with 3 of the leading varieties of soy beans. Plantings were made on five days a week apart, beginning June 1. The beginning of this series was rather late this year on account of the season. Plats were sown at a rate varying from  $\frac{1}{2}$  to  $2\frac{1}{2}$  bushels per acre. One series of plats was sown broadcast and another sown in drills. These two methods are being tested both for hay and seed production. In order to eliminate errors due to irregularity of soil, each of the above cultural experiments is repeated in 5 sets of plats.

Individual plants of soy bean are under selection in order to secure strains that are excellent seed producers and other strains that have slender stems with little wood in them for haymaking. Certain varieties are also being hybridized in the hope of combining earliness and large yield of seed and hay.

## GRASS GARDENS.

Studies on grasses and legumes have been continued in the grass garden on the Department grounds by Mr. Ball and Mr. Pollock, and a careful record has been made of those characteristics of each which bear on economic value. A set of labels showing the common and the botanical name of each species has been prepared for the benefit of those who may be interested. This collection of plants is visited annually by many people, and much valuable information is thus disseminated. Several varieties of alfalfa have attracted particular attention during the present season, and the vigorous growth of this crop in the grass garden has been the means of encouraging its cultivation in many parts of the country. The particular value of this garden lies in the fact that its location makes it easily accessible to the many visitors to



the National Capital from all parts of the country. One of the most interesting features is the miniature sand dune on which several of the leading sand binders are grown.

#### LAWN INVESTIGATIONS.

Investigations have been made by Mr. C. R. Ball on a large number of lawns in Washington and vicinity. In part, this work has been carried on at the new Chinese legation on Nineteenth street; at the Forest Glen Seminary, Forest Glen, Md.; the Washington College, Third and T streets NE., and at the residence of Mr. John S. Larcom, Washington Grove, Md. These experiments have included the reseed-ing of small areas, the application of a top dressing of fertilizer and manure, the destruction of sheep sorrel by correcting the soil acidity with lime, the destruction of various weed pests of the lawns, a study of the effect of the lime wastes from the manufacture of acetylene gas when used as a fertilizer and as a top dressing, and of the use of street sweepings for top dressing, with special reference to any injurious effects on the grass of the asphalt found in such sweepings. This work has so far been done without expense to this office, except for the incidental traveling expenses of the assistant agrostologist.

#### HERBARIUM.

There is an increasing demand on this office for determination of specimens of grasses and forage plants sent in by farmers and stockmen. The interest which has been aroused in our native plants in recent years by the investigations which have been conducted on grasses and forage plants has led to a very general recognition of the value of certain of these plants on the part of practical men, so that when any plant invades a section of country where it did not grow before it is nearly certain to be sent to this office with notes concerning it, and with request for further information. In this work the splendid herbarium maintained by this office has been of inestimable value during the past year.

A number of important additions to the herbarium have been made during the year. Among these may be noted the valuable collection of grasses and forage plants from the arid Southwest, made by an agent of the Department in prosecuting investigations in that section of country.

#### DISTRIBUTION MAPS.

Maps showing the distribution of every important grass and forage plant in this country have been prepared. A portion of these will be issued in various publications of the Bureau in the near future. They have been found to be of very great value in the work of the office, particularly in that portion of the work which relates to giving information concerning the adaptability of various crops for different sections of the country. Two sets of these maps have been prepared, one set exhibiting the actual amount of hay and forage produced, the data for which were obtained from the recent census reports. The other set was prepared from circular letters sent to a large number of farmers, requesting information concerning the important grasses and forage plants for their respective localities. Answers to these let-

ters, having thus been compiled into a series of maps, furnish us with definite information concerning the distribution of all important crops of this character in the United States.

#### CURRENT WORK.

**NATIVE GRASSES FOR HAY.**—A study of the species of wild grasses cut for hay is in progress. These grasses constitute 25 per cent of the hay crop of the country. Three representatives of the Department are now engaged in this investigation in the field. Seed of the most important grasses will be gathered for further experimentation.

**DEMONSTRATION WORK.**—Thirty grasses and forage plants, entirely new or new to certain sections, will be grown by farmers in various parts of the country in cooperation with this office. The most important of these is alfalfa, demonstration work with which will continue during the coming year. It is now certain that alfalfa is adapted to the climate and to most of the soils of the Eastern and Southern States. It is our aim now to encourage its cultivation.

**CASSAVA.**—We are growing 17 varieties of this plant and arranging to test their value as stock feed. We are preparing to test during the coming winter different methods of keeping the seed canes, and at the next planting season we shall test methods of securing a stand. With these two problems solved, cassava culture is an assured success on sandy soils adjacent to the Gulf of Mexico, where corn and other highly carbonaceous crops are not very successful.

**JOHNSON GRASS.**—Experiments in the extermination of Johnson grass are being conducted in two States on those types of soil from which it is most difficult to eradicate. Results thus far obtained indicate the complete success of some of the methods used.

**FARM MANAGEMENT.**—Particular attention will be given during the coming year to the methods required for successful stock farming in the cotton-growing districts. In connection with Dr. S. A. Knapp, a number of farms are being managed by their owners or by parties selected and paid by local committees on lines suggested by officers of the Department. Several important forage crops are grown on these farms and fed to live stock. Records are kept to show the results of the work.

Studies of the methods of farm management in actual use by successful farmers in all parts of the country will be continued. These studies will include a definite record of the crops grown, the methods used, and the results obtained by a number of the most successful farmers.

The office will continue to furnish information concerning the best crops for different sections of the country and the crop requirements of farms of different classes.

An effort will be made to secure more general recognition of the necessity of maintaining a supply of humus in the soil in those sections of the country where little attention is given to this subject at present.

**LEGUMINOUS CROPS.**—Studies on the cowpea and the soy bean will be continued. It is believed that the soy bean possesses more advantages, both as a hay crop and a grain crop, than any other annual

legume in this country. We have already found varieties adapted to all sections of the country and will introduce these into cultivation during the coming year. A study of the methods of making hay of soy beans and cowpeas will continue. The Department will continue its work in the introduction of alfalfa into the Eastern States. The more promising varieties of soy beans are to be grown in larger areas during the coming season. Those cultural experiments which promise more positive results will also be repeated on larger areas. The work of improving varieties of soy beans for hay and seed production will continue. We shall also try various combinations of fertilizers for the production of leguminous crops, as well as the effect of green leguminous manures for the production of other classes of crops.

**SOIL AND SAND BINDERS.**—During the current year plantations of sand-binding plants will be made on Clatsop Beach at the mouth of the Columbia River in Oregon; in western Michigan on the shores of Lake Michigan, and at several points on the Atlantic coast in the vicinity of light-houses. This latter work will be done in cooperation with the light-house keepers, while that in Oregon is to be done in cooperation with the officers of the United States Army stationed at Fort Stevens.

Plantations of a number of soil-holding plants will be made upon railroad embankments and on the sides of cuts, in cooperation with the engineering departments of a number of railroads in several States, using a number of plants that have been found to be of great value for such purposes.

**RANGE INVESTIGATIONS.**—The 58 square miles of land now under fence on the Santa Rita Forest Reserve in Arizona will be studied with special care. Observations will be taken on the rainfall, temperature, character of vegetation, and the effect of protection from stock. Seed of a number of promising range plants will be scattered upon selected portions of the area in order to determine what plants may be propagated in this manner on the open range under proper management. The study of the methods of range management by the most successful stockmen will be continued.

The work at the Arlington Farm and in the grass garden on the Department grounds will continue during the coming season on essentially the lines followed during the past year. Cooperative work will be continued with the various State experiment stations as follows: Soil and sand-binding plants, California; cover crops for orchards, Delaware; rotation of crops, Kentucky and Tennessee; the establishment and maintenance of meadows and pastures, Kentucky and Tennessee; the value of farm crops as feed for different cattle, Missouri; grasses and forage plants with partial irrigation in the arid region, Utah; the study of the alfalfa plant with reference to its adaptability to various types of soil, Missouri and Connecticut.

#### POMOLOGICAL INVESTIGATIONS.

There has been widespread interest in fruit culture during the past few years, due no doubt to the increasing demand for the products of the orchard and vineyard and the improved facilities for storage and transportation. The office of the Pomologist has been considerably



enlarged and its scope of work materially increased. The following brief synopsis of results accomplished is given by the Pomologist, Col. G. B. Brackett:

The correspondence of the office has been unusually large during the season, more than 12,000 letters having been written in answer to orchard inquiries alone. In addition to this there has been a distribution of 187,915 copies of bulletins concerning the methods and science of fruit culture. In the regular routine work of the office there have been 697 fruits described; 1,400 herbarium specimens added to the collection; 334 water-color paintings of fruits made, and 420 models have been added to the museum collection. The work on the varietal index has been continued with reference to completing the catalogue of the apple at the earliest date possible.

#### POMOLOGICAL FIELD INVESTIGATIONS.

The investigations under this head have continued, as in the last fiscal year, under the direction of Mr. William A. Taylor, pomologist in charge. These have comprised the following investigations: (1) Fruit and vegetable marketing with special reference to the development of export trade in these articles; (2) fruit storage investigations; (3) viticultural investigations; (4) fruit district investigations; (5) miscellaneous pomological problems.

#### FRUIT AND VEGETABLE MARKETING.

The systematic investigation of problems involved in the development of export trade in fruits and vegetables has been continued along the lines outlined in the report of last year, and is still in progress.

The principal points sought to be solved for fruits are as follows: (1) What fruits can be successfully shipped to European markets with existing land and ocean facilities for transportation and refrigeration? (2) What packages are best adapted to the transportation of each fruit capable of such shipment? (3) What size and style of package and manner of packing are best liked by purchasers? (4) What types and varieties of exportable fruits grown in this country are preferred by foreign consumers and at what seasons of the year? (5) Which of the exportable fruits can be shipped abroad with a reasonable probability of netting the shipper a return equal to or in excess of the home value?

The settlement of broad questions like these involves most thorough investigation along many lines, and experimental work must be duplicated in successive seasons as well as in different regions before accurate determinations are possible. Through the active cooperation and interest of a number of fruit growers and shippers, as well as of the officials of railway and steamship companies, a much larger number of experimental shipments has been made than could otherwise have been attempted with the means available. As the result of these shipments the following facts have been established so far as one year's experience can determine them:

(1) That carload shipments of Bartlett pears of ordinary commercial grades as grown in western New York can be landed in London in September in perfectly sound condition either in barrels, 40-pound boxes, or 20-pound half boxes. To accomplish this the fruit must be picked when hard, carefully handled, wrapped with common white

news paper, loaded immediately into iced cars, and transported in temperature of 35° to 36° F. on the steamer, the voyage on which requires seven to ten days from New York to London. A carload shipped in this way from Niagara County, N. Y., on September 9, 1902, was sold in London September 23, and netted the shipper nearly double the domestic value of the same grades of fruit, the average net value of the fruits at the packing house on all the styles of package and packing included in the shipment being about \$5.10 per barrel against a home value of similar fruit of \$2.60 per barrel.

While the pears in all styles of package in this shipment arrived in good order, it was found that those in 40-pound boxes and 20-pound half boxes netted considerably more, especially when wrapped. A comparative test of the California fruit-paper wrapper and one of common unprinted white news paper developed the fact that the latter was equal to the former in all respects, though costing less than 40 per cent as much. The gross and net values realized for the several packages and styles are shown in the following table:

*Gross and net values of Bartlett pears exported from Barker, N. Y., to London, England, in barrels, boxes, and half boxes, both with and without wrapping.*

"STANDARD" GRADE.

Package.	Style.	London price per package.	Net proceeds per package.	Net value of fruit per barrel at packing house.	Percentage of gain.
Barrel .....	Unwrapped .....	\$4.35	\$2.21	\$1.91	.....
Do. ....	California wrapper .....	5.08	2.906	2.53	32
Box .....	Unwrapped .....	1.64	1.11	3.08	61
Half box .....	do. ....	1.028	.694	4.09	114
Do. ....	California wrapper .....	1.068	.751	4.80	151
Do. ....	News paper wrapper .....	1.085	.747	5.03	163
Box .....	California wrapper .....	2.04	1.49	5.39	178
Do. ....	News paper wrapper .....	2.42	1.845	7.09	496

"SELECT" GRADE.

Box .....	Unwrapped .....	\$1.93	\$1.37	\$5.00	.....
Half box .....	do. ....	1.33	.978	6.53	30
Box .....	California wrapper .....	2.43	1.85	6.61	32
Do. ....	News paper wrapper .....	2.48	1.895	6.99	39
Half box .....	California wrapper .....	1.51	1.15	8.25	65
Do. ....	News paper wrapper .....	1.53	1.17	8.61	72

Experience for two successive seasons indicates the entire practicability of profitable exportation of this pear to London in carload lots from western New York in years like 1901 and 1902 when the excess of value in foreign over home markets renders such shipments advisable. It is believed that the next season of large pear crops will witness a considerable commercial development along this line.

(2) That while there is an extensive and increasing demand for the Kieffer pear in the principal markets of the United Kingdom, this variety is not desired, nor can it be profitably marketed on the continent of Europe. It has also been demonstrated that under some conditions of growth and ripening this pear needs refrigeration for export shipment. More experience is needed along this line.

(3) That such standard commercial varieties of the peach as Elberta can be successfully exported from Georgia and Connecticut to London

in July and September, as well as the later, firmer fleshed varieties from the mountain orchards of West Virginia. The practicability of such shipments having been demonstrated, the question of the best package for this trade remains to be settled. The six-basket carrier generally used in the South, with which most of the tests were made, is in some respects not well adapted to export shipment, and more compact packages need to be tested. At the close of the fiscal year there are strong indications that extensive shipments will be undertaken by commercial shippers along lines determined through the experimental shipments.

(4) That some of the leading summer apples of the Middle Atlantic States, such as Delaware, can be delivered in London in excellent condition and sold at high prices in July and early August. Varieties found especially useful in this connection last season were Yellow Transparent, Colton, Red Astrachan, Fourth of July, Williams, Early Strawberry, and Randolph. The question of best package for these still remains to be determined.

(5) That in years like 1902, when the European crop of apples and other fruits is rather light, winter apples that are fairly mature and well colored can be profitably exported as early as August. A carload of early-packed Ben Davis and Winesap, shipped from southern Illinois in August, to London, realized an average of \$3.12 per barrel for the former and \$3.36 for the latter, at shipping point, indicating the practicability of lengthening the marketing season by making earlier shipments in such years.

(6) That the question of best package for exporting the bulk of the American winter apple crop is an unsettled one at the present time and must be worked out through a series of comparative shipments to different European markets. Preliminary shipments made in barrels and boxes to London, Liverpool, Glasgow, and Hamburg yielded discordant and contradictory results both as to package and style of packing. These must be continued under such circumstances as will yield more decisive results before safe conclusions can be reached.

(7) That the Paris market, which first received direct commercial shipments of American apples early in 1903, will take considerable quantities of Russet varieties at prices sufficiently high to more than compensate for the heavy freight rate and duty on such fruit, which amount at the present time to about \$1.75 per barrel. Most of the red varieties so popular in America are apparently not desired in Paris.

Shipments of sweet potatoes from Virginia, Delaware, and New Jersey were made during the fall and early winter to further test the possibilities in this direction. While the demand for these in London appears to be increasing gradually, and shipments arriving there in sound condition bring good prices, it has been found very difficult to deliver sound stock on the other side later than about November 1 with existing ocean facilities. The subject needs expert investigation at the foreign end of the line.

#### FRUIT STORAGE.

Since the last report the investigations of the cold storage of fruits have been continued under the direction of Mr. G. Harold Powell, assistant pomologist. The cold-storage business has assumed large commercial proportions, but the general principles which govern the preservation of fruits by cold temperatures are not well understood.



These investigations are now generally recognized by practical storage men as aiding in the correction of many of the errors and abuses now existing in the cold-storage business and as helping to establish such methods of growing and handling fruits as will insure good-keeping qualities and their highest value to the consumer.

Cooperative storage experiments with fruits have been conducted in Philadelphia, Pa., Hartford, Conn., Boston, Mass., Buffalo, N. Y., Chicago, Ill., and Kansas City, Mo., as well as in Washington, D. C., using fruit from Georgia, Virginia, West Virginia, Delaware, Maryland, New York, Massachusetts, Maine, Michigan, Missouri, Illinois, and Kansas.

It has been found through these tests that apples and peaches that reach their highest color and growth on the trees, but are still hard when picked, are equal to the less mature fruit in keeping quality, except that such fruit may need picking earlier from trees that are growing abnormally fast than from trees of normal vegetative vigor; that all fruit should be stored quickly after picking to prevent undue ripening before storage; that delays in storing are most injurious in hot weather and to those fruits and varieties that normally ripen quickly; that the ripening of apples, pears, and peaches in the storage house is delayed more in a temperature of 32°F. than in a higher temperature, and that the fruit rots and molds that attack stored fruits are less troublesome in the lower temperature; that the aroma, flavor, and quality of storage fruit is injured more by improper management of storage rooms than by low temperature in them; that susceptibility to "scald," one of the most serious apple-storage troubles, may be reduced to a minimum by growing highly colored, well-developed fruit, storing it quickly after picking in a temperature not above 32° F., removing the fruit for use before "scald" appears, and after removal holding it in a low temperature.

Fruits like the Bartlett pear or the peach that ripen and are stored in hot weather need to be cooled quickly to prevent after-ripening. Fruit cools most quickly in a small storage package, and if it is to be stored for a short time only, a ventilated package assists rapid cooling; but fruits like winter apples that are to be stored for a long season shrivel if stored in open packages.

A comprehensive storage test of important small fruits, including strawberries, red and black raspberries, blackberries, currants, and gooseberries, is in progress at Washington at the close of the fiscal year. In this test comparisons of early and late pickings of the same varieties, and of the typical packages used for such fruits on the Atlantic slope and in the Mississippi Valley and Lake regions are being made, as well as the usual comparison of temperatures and the effect of delay in storage upon the keeping quality of the stored product. These tests are under the immediate personal supervision of Mr. S. H. Fulton, assistant in pomology.

#### VITICULTURAL INVESTIGATIONS.

The experimental vineyards at Southern Pines, N. C., and Earleton, Fla., were continued. At Southern Pines it has been shown that certain *Vinifera* varieties grafted on resistant stocks, under the same treatment as is given American varieties, will produce fully as much fruit, and perhaps more and of better quality, than the American

varieties grown there. At Earleton the conclusions of last year regarding resistant stock were verified, namely, that *Riparia* varieties will not, on account of their surface-spreading root system, be able to stand the hot summers. On the other hand, the *Rupestris* and *Aestivalis* varieties seem to stand it nicely. Florida's peculiar climatic conditions also suggest an entirely new method of pruning, training, and cultivating.

Trips of investigation have been made through portions of New York, the Southern States, and parts of Idaho and Colorado, and along the Atlantic coast and the Pacific slope, looking into viticultural conditions and probabilities. In all the districts visited much missionary work is needed in improving the conditions and methods practiced and in introducing proper varieties.

On the Pacific coast certain conditions prevail which threaten serious injury to the viticultural industry unless means are devised affording relief. Thousands of acres of flourishing vineyards have been destroyed, and in one district alone the product has in two years been reduced from 6 million to one-half million gallons of wine. On the urgent appeals of vineyardists in California two experimental vineyards were established, one at Oakville, the other at Fresno, Cal., at each of which about  $4\frac{1}{2}$  acres have been planted to resistant vines (comprising about 70 varieties). It is the intention to rapidly increase the number of varieties and to locate other vineyards during the coming year. It is proposed to bring together for observation and test all the known resistant stocks of the world which give any indication of value to the American vine grower for the purpose of determining their adaptability to the soil and climatic conditions of the Pacific slope and their congeniality as grafting stocks to the improved commercial *Vinifera* varieties. Incidentally, it is also proposed to assemble as complete a collection of the *Vinifera* varieties of all countries as can be procured, with a view to correcting the existing confusion in the nomenclature and to determining the adaptability of these varieties to localities and their value for different uses. For this purpose, cuttings from 138 different *Vinifera* varieties have already been procured and are now being rooted by the Department.

#### FRUIT DISTRICT INVESTIGATIONS.

The work in this field has been in charge of Mr. H. P. Gould, assistant pomologist, and has been chiefly in continuation of that inaugurated in 1902. Its purpose is to determine as accurately as is possible the relative adaptability of fruit varieties for commercial planting in the several important fruit regions of the country. The problems involved are very complex, including, as they do, the varied conditions of latitude, soil, elevation, and slope, as well as rainfall, humidity, maximum and minimum temperatures, dates of blossoming and vernalization, and other data bearing upon the vegetative vigor and the productiveness of fruiting trees, vines, and plants, as well as the marketability of the product.

Extensive cooperative observations of the dates of blossoming, leafing out, and ripening of the tree fruits are in progress throughout the United States and British America, being participated in by about 700 fruit growers, whose reports are forwarded to the Department at the close of the season.

Through the correlation and comparison of the data thus received it is believed that fairly accurate generalizations regarding the climatic regions to which leading varieties are adapted can be formulated. In this connection, phenological studies are being conducted in several large varietal fruit collections that have been placed at the disposal of the Department for this purpose.

At the same time the assistant in charge devotes most of the growing season to the investigation of orchard conditions in the regions that are under special observation in order to determine by actual comparison in the field the particular soils, slopes, elevations, etc., that are best adapted to the several kinds of fruit. Field work during the year 1903 has been mainly devoted to orchard investigations in the Blue Ridge regions of Pennsylvania, Maryland, and Virginia, and in continuation of that begun in 1902 in the Piedmont region of Virginia. A preliminary survey of the Ozark region of Missouri and Arkansas was made late in the year for the purpose of outlining future work in that section. While work of this character requires repeated observations before accurate generalization is possible, it is believed that by the close of the present season the results will justify a preliminary publication on the conditions in the Piedmont region of Virginia and North Carolina.

#### MISCELLANEOUS PROBLEMS.

Under this head several important problems have been under investigation, notably the rapidly developing pecan industry of the South, and the classification and climatic requirements of the various groups of peaches that have assumed commercial importance in various parts of the country. Bulletins on both of these subjects are now in preparation.

#### CURRENT WORK.

##### FRUIT MARKETING.

During the present fiscal year it is proposed to work out certain phases of the peach and summer apple problems by continuing shipments of these fruits abroad; to undertake comprehensive work on winter apples, for which the shipments of last year paved the way, and to undertake certain tests with other fruits that seem worthy of attention because of the rapidly increasing supply. A preliminary investigation of methods used in the cooperative marketing of fruits, which appears highly desirable, is also contemplated, as the assembling and proper handling of fruits for export in many sections appear to necessitate cooperative effort.

##### FRUIT STORAGE.

In the fruit-storage work the following lines are under way:

(1) Continuation and extension of an investigation of the influence of cultural conditions on the keeping of fruits, including sod *v.* tillage, young *v.* old trees, overgrown *v.* medium-sized fruit, highly colored *v.* poorly colored fruit, in apples.

(2) Continuation and extension of the investigation of influence of methods of handling fruit on keeping quality, including different packages, immediate *v.* delayed storage under various existing commercial conditions, fruit wrappers on apples, pears, peaches, and small fruits.



(3) Continuation and extension of investigation of the effect of different storage temperatures on apples, pears, peaches, and small fruits.

(4) Preliminary study of refrigerator-car temperatures on peaches in transit and in storage.

(5) Apple scald and the development of fruit fungi in different storage temperatures, in cooperation with the Pathologist and Physiologist.

(6) Chemical changes in storage fruit, in cooperation with the Bureau of Chemistry.

(7) Preliminary survey of the citrous and deciduous fruit interests of the Pacific coast and Rocky Mountain fruit regions, with a view to investigating certain storage problems that are being urged upon the Department by fruit growers and storage men there.

#### VITICULTURAL INVESTIGATIONS.

As previously noted, two experimental vineyards have been, and others are to be, established in conjunction with the office of Seed and Plant Introduction and Distribution. In these vineyards the following investigations will be made:

(1) A comprehensive test of the resistant varieties of vines to determine their adaptability to the different vineyard soils and climatic conditions.

(2) A study to determine the congeniality of the *Vinifera* and the different resistant varieties.

(3) A study to ascertain which varieties are best adapted to the different localities.

(4) A study to afford opportunity for testing all classes of grapes with reference to their resistance to a disease which has been doing serious injury to the vineyards, and if found necessary to undertake the creation of an entirely new class of grapes better adapted to Pacific coast conditions.

Of the two experimental vineyards that have been established for this purpose, the one at Oakville, Napa County, Cal., is in one of the leading wine-producing districts; the other, near Fresno, Cal., is in the leading raisin-producing district. At each of these places plantings of about  $4\frac{1}{2}$  acres have been made, consisting of some 70 varieties of resistant stock. During the present fiscal year it is proposed to increase the plantings made at each of these localities by the addition of several hundred varieties of resistant stock. In view of the entirely different conditions prevailing south of the Tehachapi Pass, especially in the desert regions, another experimental vineyard of like importance is to be located there. These three plots are expected to be of a permanent nature, involving the introduction of viticultural specimens from all parts of the globe, and are intended to develop into broad viticultural research places, serving not only as practical object lessons to those interested in the industry, but also as an excellent means of correcting the nomenclature of varieties and solving many other problems of great commercial interest.

It is also contemplated to establish smaller outlying vineyards of from 1 to 3 acres each for testing varieties in other vineyard soils and under different climatic conditions than are found in the three larger vineyards, such as gravelly, clayey, chalky, calcareous, alkaline, shal-

low, and hillside soils, higher and lower altitudes, and the climatic conditions caused by nearness to and distance from the ocean, bays, and other bodies of water.

The experimental vineyards at Southern Pines, N. C., and Earleton, Fla., are being continued for the purpose of making notes on the comparative commercial value of the *Vinifera* varieties fruiting in them as well as of the value of the resistant stock varieties for conditions found there. It is also thought that the hundred and more varieties of *Vinifera* found true to name that have been closely studied while growing in these vineyards will prove valuable for distribution purposes and for viticultural work in California and elsewhere, where investigations with *Viniferas* are being made.

An extensive study of Florida during the last season leads the viticulturist to conclude that quite different methods of pruning, training, and cultivating from those practiced elsewhere should be used in Florida viticulture. Little difficulty is found in making certain varieties of vines grow in Florida, but in most sections of the State it is almost impossible to find the vines dormant enough at any time of the year to prune them without affecting them too severely.

At Southern Pines, N. C., there appear to be no insurmountable difficulties in growing grapes profitably except that of securing labor skilled in viticultural operations, without which it is exceedingly difficult to properly spray, prune, and cultivate the vines and to market the grapes in a systematic and correct manner.

Trips of investigation are contemplated to various viticultural districts, and a careful study of existing conditions in California will be necessary before locating work now, and to ascertain what will be necessary during the coming year. Many new features are constantly presenting themselves, as the industry, though already assuming considerable proportions, is yet in its infancy. Much still needs to be developed, and it is only by keeping in close touch with those in the industry that the errors of the past can be avoided and the industry in this country placed where it should be.

Miscellaneous experiments are being carried on at the Department, where a number of *Vinifera*, as well as resistant stock varieties, are being studied while they are rooting in nursery rows. The cultural experiments upon their own roots, as well as on resistant stocks grown to fruiting stage in pots, are being continued and will afford opportunity for studying the behavior of many varieties under glass.

#### FRUIT DISTRICT INVESTIGATIONS.

The promising outlook for the development of export trade in summer apples in 1902 having aroused much interest in this branch of apple culture along the Atlantic seaboard, it is deemed desirable to pay special attention immediately to the determination of the areas within which the early varieties of this fruit may be grown to best advantage and profit.

The orchard-to-orchard investigation of the Piedmont regions of Virginia and North Carolina will be prosecuted throughout the growing season, and such observations as are practicable will be made in the Blue Ridge region of Maryland and Pennsylvania. The collection of phenological data from all important districts will be continued during the year.

## HORTICULTURAL INVESTIGATIONS.

## GARDENS AND GROUNDS.

The area occupied by the gardens and grounds of the Department of Agriculture has not been materially altered since the last annual report. The use to which the several areas are put, however, has been somewhat changed. The usual miscellaneous collection of flowering plants grown in the regular gardens has been, during the present season, replaced by a very complete collection of annual flowering plants, in order that the adaptability of these plants to our climate, as well as their fitness for use in the seed distribution, may be determined. The tree and shrub plantations have not been materially altered, except to replace some of the missing trees by new specimens and to remove those which have become unsightly from one or another cause.

## LAWNS.

The same painstaking care has been exercised by the superintendent, Mr. E. M. Byrnes, in maintaining the lawns about the building as in previous years. Two interesting troubles have occurred during the season, one in the form of a fungous disease which attacks the clover. This was called to the attention of the Pathologist, who has had it under consideration and now reports that it is apparently a new disease, evidently not being the one described in Germany as attacking clover. Certain other areas in the lawn have been infested with plant lice, which caused the stems of the grass to redden and die. This is also under investigation.

## ECONOMIC PLANTS.

The east lean-to of the conservatory is given up to a collection of economic plants, principally from tropical and subtropical regions, brought together under the direction of the Botanist. This collection is of extreme importance to students of economic plants, as it is one of the largest and most complete collections of its kind in the United States.

## TROPICAL FRUITS.

The orange house, so called, which contains a collection of tropical fruits such as oranges of various classes, lemons, figs, loquats, and olives, has furnished a supply of bud and cutting wood which has been extensively used in disseminating these choice varieties to different sections of the United States suited to the cultivation of such plants.

## CARNATIONS.

The same plan of growing carnations which was outlined in the previous year's report has been followed with good success during the current fiscal year. The plan of never growing the carnation outdoors is, we believe, much more satisfactory for the commercial growers than the outdoor plan usually followed. While this scheme requires the use of a house throughout the entire year, it nevertheless overcomes the great shock to which the plants are subjected in lifting them in the autumn, and results in a very much larger and earlier yield of flowers. The scheme is, therefore, admirably adapted to the use of those who wish to produce flowers for the Holiday trade.



## EASTER LILIES.

A large collection of seedling lilies has been grown during the year and will be distributed to different localities along the Gulf coast and in California, which localities seem to promise suitable conditions for their development. A report on the condition of those sent to California during the last year indicates that this section may be a possible field for the successful development of these lilies.

## CHRYSANTHEMUMS.

During the year 122 varieties were collected and grown in pots of suitable size to allow the plants to be used for exhibition purposes. Instead, however, of following the customary plan of training the plants to a single stem, the principle adopted in the growth of the chrysanthemums produced at the Department was to develop the bush form, carrying from 10 to 20 blooms per plant. This of course required the use of larger pots, but, on the other hand, reduced the number of specimens. However, some 900 specimens were produced and successfully brought into bloom. The plants were properly labeled with their popular names, and the public was admitted to inspect them. During the blooming period of these plants they were arranged in the graperies of the Department; arc lights were temporarily arranged in the building so as to allow those who could not visit the display during the day an opportunity to see it by artificial light. During the time the exhibition was open, a period of eighteen days, beginning October 23 and closing November 10, the attendance averaged about 2,000 persons daily. The educational value of such a display can not be estimated, for people not only gained an appreciation of what has been accomplished by scientific and practical horticulturists, but they acquired an appreciation of the æsthetic value of high-grade products. The greater the number of varieties displayed and the more diverse the methods of training, the greater the instructive value of such a display. The press and the public have expressed their appreciation and approval of this effort of the Department by the many complimentary notices which have been given and by the large and increasing attendance from day to day during the course of the display. We believe this exhibition is justified on the ground that it is highly educational, and gives the public an opportunity to note the wonderful modifications which have been produced in this oriental flower during the period it has been under cultivation by gardeners.

## SCHOOL GARDEN WORK.

A small area of the cultivated ground has been turned over for the use of Miss Susan B. Sipe, botanist of Franklin Normal School of the District of Columbia. This area is divided into 27 small gardens, each of which is maintained by an individual student of the fifth grade of one of the graded schools in the vicinity. The children cultivating these gardens are from 10 to 12 years of age. The collection of plants grown in these small areas has been selected for the purpose of giving the young people an opportunity to grow both vegetables and flowering plants. The sorts and the plantations have been so arranged as to allow for a rotation of crops on the area devoted to vegetables. This has proved very successful, and we believe that the lessons received in the garden will have a very desirable and lasting influence upon the

young people who have undertaken the work. In addition to the school-garden work at the Department, Prof. C. F. Wheeler, who is in charge of the economic plantations of the Department, has been placed in charge of a school-garden scheme to be developed in connection with the Department's exhibit at the Louisiana Purchase Exposition at St. Louis. Professor Wheeler has already made extensive collections of seeds and plants to be used upon the grounds of the Department at the Exposition. We expect that this exhibition, if it proves as successful as the trial made upon the Department grounds, will be a very great addition to the educational feature of the Department's display.

#### PLANTS PROPAGATED AND DISTRIBUTED, ETC.

During the year the work shown in the following tables has been carried out by the force of Gardens and Grounds:

*Plants propagated during the season of 1902 and 1903 for use on the grounds and for distribution.*

Name.	Number of varieties.	Number of plants.	Name.	Number of varieties.	Number of plants.
Alternanthera.....	3	3, 197	Gypsophilla.....	4	75
Alyssum.....	8	200	Godetia.....	13	250
Amaranthus.....	8	525	Gomphrena.....	8	75
Abutilon.....	1	976	Helichrysium.....	6	125
Ageratum.....	8	315	Heliotrope.....	1	422
Acalypha.....	3	683	Helianthus.....	14	170
Ammobium.....	3	50	Iresine.....	2	3, 026
Ampelopsis.....	1	4, 000	Lychnis.....	2	25
Aster.....	6	3, 550	Lobelia.....	4	100
Antirrhinum.....	1	300	Lupinus.....	7	75
Balsam.....	12	250	Marigold.....	16	300
Begonia.....	3	1, 004	Mignonette.....	19	980
Browallia.....	3	100	Nasturtium.....	64	4, 000
Beets.....	7	125	Nemophila.....	7	150
Candytuft.....	16	1, 800	Nicotiana.....	7	175
Coleus.....	11	16, 070	Oenothera.....	7	100
Calendula.....	11	200	Petunia.....	28	703
Chrysanthemum.....	190	3, 210	Phlox.....	25	2, 500
Clarkia.....	4	75	Poppy.....	27	550
Carnation.....	16	2, 117	Roses.....	12	6, 708
Calliopsis.....	10	200	Ricinus.....	1	350
Centaurea.....	16	1, 080	Rudbeckia.....	4	100
Celosia.....	21	400	Salvia.....	3	355
Cosmos.....	24	1, 000	Scabiosa.....	4	75
Convolvulus.....	6	125	Shrubs.....	9	11, 136
Dahlia.....	1	21	Snapdragons.....	13	250
Datura.....	5	75	Sweet Peas.....	49	.....
Delphinium.....	7	1, 600	Verbena.....	18	3, 740
Dianthus.....	29	2, 720	Vines.....	54	3, 076
Eschscholtzia.....	10	200	Zinnia.....	31	850
Fuchsia.....	7	1, 400	Miscellaneous.....	81	5, 318
Gaillardia.....	12	250			
Geranium.....	8	4, 501	Total.....		98, 078

#### Bedding plants on grounds.

Feverfew.....	200	Geranium.....	950
Aster.....	700	Coleus.....	1, 300
Dianthus.....	175	Artemisia.....	450
Phlox.....	175	Alternanthera.....	2, 000
Snapdragon.....	200	Begonia.....	400
Carnation.....	350	Verbena.....	1, 500
Mignonette.....	400	Torenia.....	400
Hardy Dianthus.....	100	Petunia.....	300
Hardy Aster.....	75	Dahlia.....	200
Salvia.....	475	Gladiolus.....	2, 000
Abutilon.....	425		
Canna.....	200	Total.....	13, 155
Vinca.....	280		

*Annual flowering plants on grounds.*

Gladiolus .....	2,500	Gypsophilla .....	75
Delphinium .....	1,600	Celosia .....	400
Dianthus .....	2,000	Datura .....	75
Phlox .....	1,900	Nicotiana .....	175
Candytuft .....	1,800	Rudbeckia .....	100
Alyssum .....	200	Salvia .....	1,500
Ageratum .....	175	Scabiosa .....	75
Petunia .....	550	Browallia .....	100
Aster .....	2,500	Ammobium .....	50
Verbena .....	450	Godetia .....	250
Calendula .....	200	Zinnia .....	850
Marigold .....	300	Convolvulus .....	125
Eschscholtzia .....	200	Lobelia .....	100
Balsam .....	250	Nemophila .....	150
Clarkia .....	75	Helichrysum .....	125
Lychnis .....	25	Lupinus .....	75
Centaurea .....	300	Gomphrena .....	125
Gaillardia .....	250	Helianthus .....	170
Poppy .....	550	Snapdragon .....	250
Carnation .....	2,064	Amaranthus .....	125
Mignonette .....	400	Chrysanthemum .....	2,698
Oenothera .....	100	Cosmos .....	800
Nasturtium .....	3,800		
Calliopsis .....	200	Total .....	30,942

*Distribution of plants, bulbs, etc.*

Bedding plants .....	15,991	Palms .....	505
Bulbs:		Privet cuttings .....	10,663
Congressional distribution ..	143,095	Roses .....	2,970
Miscellaneous distribution ..	41,021	Rubber plants .....	270
Camphor plants .....	3,109	Shrubs .....	4,013
Chrysanthemums .....	383	Strawberry plants:	
Citrus trifoliata .....	137	Congressional distribution ..	59,634
Coffee .....	17	Miscellaneous distribution ..	7,938
Dracæna .....	173	Tea plants .....	2,133
Ferns .....	231	Trees:	
Fig cuttings .....	1,934	Congressional distribution ..	38,228
Grapevines:		Miscellaneous distribution ..	14,395
Congressional distribution ..	16,656	Vines .....	2,759
Miscellaneous distribution ..	4,362	Miscellaneous .....	4,892
Greenhouse plants .....	1,000		
Olive plants .....	250	Total .....	376,759

## COOPERATIVE WORK.

As was noted in the last annual report, one house of the range of houses belonging to Gardens and Grounds was turned over to the Pathologist and Physiologist, and has since been devoted to the growth of plants for the purpose of studying their physiological and pathological conditions. This house, as was before noted, is called the "Plant infirmary." The cooperative work between Gardens and Grounds and the office of Seed and Plant Introduction and Distribution has this season taken the form of cultivating upon the grounds an extensive collection of annual flowering plants. This work is, as has been before noted, for the purpose of studying the fitness of these various plants for the seed distribution, and for the educational value which will come from having such a collection in a position where the visiting public can inspect and study it.



## PERMANENT IMPROVEMENTS.

With the opening of the current fiscal year an effort was made to coordinate the labor of caring for the plants grown under glass. Accordingly, three return-tube 40-horsepower horizontal boilers were installed for the purpose of supplying steam for the whole greenhouse system, which, up to that time, had been piped with 4-inch cast-iron pipe and each house heated by an independent boiler, with the exception of three houses which were heated by steam from two boilers in one boiler pit. The location of the new heating plant, together with the idea of centralizing the work of potting in one building, involved the construction of a boiler house and potting shed 18 by 150 feet in length, and the extension of two of the existing houses in order to bring them up to the new building line. The house known as the S. P. I. house, which is 24 feet wide, was extended some 20 feet, and its companion, known as the carnation house, was extended some 30 feet, thus adding 1,200 square feet to the area of the plant. In addition to remodeling the piping in five of the old houses, and building the two additions above mentioned, three new houses, each 150 feet long and 10 feet wide, have been erected and equipped with steam heat.

The change effected by this improvement has resulted in centralizing the storage of pots and potting soil into a single workroom; has rendered it possible to handle a large percentage of the small stuff in a single potting room; and has not only coordinated the work but has had the effect of bringing the force more directly under the eye of the superintendent. Not only this, but when the work of repiping shall have been completed the number of fires upon the place will have been reduced from eleven to three, the quantity of coal lessened, and the labor of firing diminished. This improvement is the most radical and most important inaugurated since the establishment of the work along this line in the Department.

## PLANS FOR FUTURE WORK.

The same general line of educational and experimental work that has in the past characterized the management of Gardens and Grounds will be continued. The details of this work have, during the year, been placed more fully under the direction of Mr. E. M. Byrnes, who is in immediate charge of the work of Gardens and Grounds.

It is proposed to remodel the orange house during the coming year so as to more adequately fit it for the increased size of the citrous trees protected by it and to repipe it for steam. The large conservatories are in a very dilapidated condition, and, while our funds will not admit of rebuilding or even remodeling them, it is absolutely necessary to repipe them so as to heat them by steam, because the old hot-water boilers have become unsafe. The collection of plants housed in this antiquated and dilapidated conservatory is one of the finest of its type now in existence in the United States, and is the result of many years of patient, painstaking collecting from all quarters of the earth. The collection is priceless in value and deserves a commodious, modern steel structure for its protection. It is therefore recommended that in the scheme of improvement now under contemplation by the Depart-

ment adequate and appropriate provisions be made for these valuable plants. At least \$150,000 should be expended in such a building and its accessories.

#### ARLINGTON EXPERIMENTAL FARM.

No description of this farm is necessary other than to say that it is located in Virginia, opposite Washington, D. C., and is a portion of the original tract of land acquired by the Government of which the Arlington National Cemetery is a part. The work on the farm has been in charge of Prof. L. C. Corbett, who submits the appended report:

##### SOIL IMPROVEMENT.

During the year the work of soil improvement has been pushed with all the energy possible with the force at the disposal of the Department. The drainage system has been somewhat extended, cowpeas have been extensively planted on the newly broken areas, and other crops which would tend to benefit the mechanical as well as the physical conditions of the soil have been used, so that now, at the close of the third year, the upland portion of the farm has all been brought under cultivation; nearly every acre has produced a crop of cowpeas, which has been turned under and followed by a crop of rye. Following the rye, clover and timothy have been seeded, so that the areas not used for experimental purposes are now practically all covered with a seeding of grass. The unsightly condition which was caused by numerous galls and bare places has been so changed as to give the farm the appearance of a cultivated area.

##### PERMANENT PLANTINGS.

Some permanent plantings have already been made. An experimental orchard consisting of apples, pears, plums, and peaches, for the purpose of studying the physiological effect of insecticides and fungicides upon the health of the trees, has been put out. A home fruit garden, covering an area of 1 acre, contains the following fruits: Apples, 25; peaches, 45; crab apples, 5; dwarf pears, 32; standard pears, 10; plums, 18; cherries, 18; quinces, 9; dewberries, 50; blackberries, 150; red raspberries, 150; currants, 75; gooseberries, 50; grapes, 80; strawberries, 1,000. While this garden can not be considered as a permanent plantation, the design is to determine the actual return in quantities of fruit which an acre planted on fairly good soil will yield under good treatment. There is also upon the farm a half-acre lot on which is maintained what may be called an ideal home vegetable garden. This garden is so planned as to admit of a rotation of crops, and contains a collection of vegetables which would supply a table throughout the year. The object is to determine the best rotation or succession of crops upon such an area and to furnish records which will show the value of such an area in the farm economy.

##### NURSERY WORK.

The nurseries at the farm now cover an area of about 4 acres. Upon this area there is growing a collection of 403 varieties of apples and 152 varieties of peaches, together with about 1,700 seedling pears

which have been grown from seeds artificially cross-pollinated by Mr. M. B. Waite. These plants will ultimately form a portion of the permanent orchard plantation of the farm. The following presents a summarized statement of the plants now growing in the nursery:

*Economic fruits.*

Apple .....	2,418	Plum .....	9
French apple.....	50	Peach .....	608
Western apple.....	50	Apricot .....	10
Common apple.....	500	Pear .....	32
Dwarf apple.....	25	Cherry .....	100
Pear, seedling hybrid (Waite's) ..	1,700	Strawberries .....	4,000
French pear .....	75		
Quince .....	220	Total .....	9,797

*Ornamental trees transplanted.*

Silver maple .....	2,500	Ulmus americana.....	500
Fraxinus excelsior.....	75	Taxodium .....	800
Tilia americana.....	500	Juglans nigra .....	500
Celtis occidentalis .....	200	Juglans regia .....	2,000
Liriodendron tulipifera .....	1,500		
Catalpa speciosa .....	1,500	Total .....	10,075

*Plants propagated from seeds and cuttings.*

Quercus palustris .....	3,800	Pecan.....	1,000
Quercus rubra .....	4,200	Mulberry .....	8,000
Quercus pedunculata .....	3,000	Privet .....	3,200
Quercus coccinea .....	400	Lilac .....	1,000
Quercus cerris .....	1,200	Sophora japonica .....	250
Quercus hindsii .....	200	Euonymus .....	100
Quercus phellos .....	800	Tamarix .....	25
Quercus laurifolia .....	200	Deutzia crenata .....	50
Fraxinus viridis .....	2,400	Bamboo .....	21
Cytisus laburnum.....	50	Miscellaneous .....	100
Zelkova crenata .....	300		
Cork oak.....	300	Total .....	30,596

The forest trees which are included in the above list are designed for two purposes: (1) To be used in connection with the Congressional distribution of trees and plants, and (2) the larger ones to be used in the ornamental plantations about the buildings upon the farm.

PERMANENT IMPROVEMENTS.

In the way of permanent improvements there has, during the course of the year, been erected on the farm a brick barn which is practically three stories high and 40 by 100 feet in extent. This furnishes adequate shelter for the teams and tools which are necessary in conducting the work of the farm, and provides granaries and storage room for such forage as is required to maintain the farm animals. The barn, while not ornamental in any of its features, has been planned with reference to its utility, and we believe will furnish adequate shelter of this description for years to come. The idea has been to make it permanent and substantial rather than ornamental.

TEAMS, TOOLS, AND IMPLEMENTS.

During the year the horsepower of the farm has been increased, so that at present there are 5 head of horses and 5 head of mules availa-



ble for use in carrying on the work. The supply of farm implements has been increased, and, while lacking a few special implements, there is a very good working outfit of plows, harrows, drills, mowers, rakes, etc.

#### COOPERATIVE WORK.

The cooperative work conducted constitutes a very important feature of the farm. Some 12 acres have, during the current year, been devoted to investigations of forage plants under the immediate supervision of the Agrostologist. About 4 acres have been used by the office of Vegetable Pathological and Physiological Investigations in studying the various root organisms which are beneficial to leguminous crops; and for the work of plant breeding with oats, corn, rye, and other crops, about 50 acres are under cultivation by the Plant-Breeding Laboratory. A small area is given up to the growth of economic drug plants, under the direct supervision of the Botanist.

#### COOPERATIVE TESTING WORK.

During the year a plan has been put in operation which, if successful, will result in placing at the disposal of the Department a series of annual records of the behavior of various garden or truck crops in the several States. A set of note blanks has been prepared which provide for a uniform system of note taking by all growers of such crops. At the present time 27 of the horticulturists of the Federal experiment stations throughout the country are using these blanks for noting the growth and development of the various truck crops which they are studying. At the close of each season a duplicate set of these blanks is to be filed in the office of the Horticulturist, which will place at the disposal of the workers of the Department a comparative statement of the behavior of various truck crops in the several States in which they are grown. This will ultimately be of great value in determining the geographical distribution of varieties, as well as their longevity. It will also furnish data which will enable those interested in the distribution of seeds and plants to place in the various quarters of the United States those particular varieties which are best suited to the region. An incidental result which is likely to come from this line of work is that of reducing, to a considerable extent, the multiplication of names of the cultivated varieties of vegetables. If these results are accomplished a great step in the improvement and simplification of the nomenclature of horticultural varieties of truck crops will be attained.

#### PUBLICATIONS.

During the year the office of Horticultural Investigations has published Farmers' Bulletins No. 157, on "The propagation of plants;" No. 176, on "Cranberry culture;" an article in the Yearbook for 1902 on "Plants as a factor in home adornment;" besides numerous newspaper articles.

#### WORK OTHER THAN THAT CONNECTED WITH GARDENS AND GROUNDS, OR WITH THE ARLINGTON FARM.

During the current year the Horticulturist has visited the truck-growing regions along the Atlantic coast from Washington to Florida,

has familiarized himself with the conditions of this branch of horticultural work, and urgently recommends that some steps be taken to provide for meeting some of the important problems which the people of these regions have to face. It is very desirable that a careful crop survey be made of these sections in order that the best results may be secured in the way of rotation of crops to meet the market demands of the large centers of consumption situated at the North. In addition to such a survey, some plan of cooperative work is needed, having for its object the solution of the many cultural problems which present themselves in connection with the peculiar conditions arising from the intensive methods of cultivation necessary in producing these truck crops. The industry has assumed such large proportions that at the present time individual growers are cultivating as many as 700 acres in various truck crops, and the industry is, in certain other regions, so intensive that a single area is made to produce four crops during the twelve months; a single acre, during the past season, has produced a net return of more than \$1,000 from a single crop. This industry, as will readily be seen, is an exceedingly important one. Upon it we are depending for our supply of fresh vegetables throughout the greater portion of the year, and its extent is sufficient to place in the markets of northern cities an almost continuous supply of all the desirable vegetables throughout the twelve months of the year. In view of the fact that up to the present time the Department has given little or no attention to this industry, and that it is not recognized by special investigations by any of the State experiment stations, it would seem wise to make some provisions for meeting the problems which are presented. It is the desire of the Horticulturist, if possible, to aid those engaged in this important intensive industry to solve as many of their problems as practicable.

#### PLANS FOR FUTURE WORK ON ARLINGTON FARM.

The work of amelioration and preparation of the soil at the Arlington Farm has progressed sufficiently to admit of devoting extensive areas to the more important work of special crop studies; and from now on it will be the aim in the management of the farm to so arrange the work as to solve a number of the important problems connected with plant cultivation, plant propagation, and plant nutrition. In connection with the work of the truck growers and florists, it is intended to install suitable glass area and to arrange sufficient areas covered with canvas and cloth shade to study the influence of shade and protection upon the growth and development of such vegetable crops as lettuce, celery, radishes, beans, etc., which, when grown out of season, return large revenue from a small area. The present plan is to construct at least two glass houses 20 by 100 feet in extent, and to erect shade of slats and cloth over areas for the growth of the crops above noted.

The orchard trees in the nursery, mentioned elsewhere, will be ready for planting during the coming year, which will very materially augment the permanent orchard planting of the farm. In addition to this, it is proposed to study upon certain areas of the farm the physical changes which are brought about by proper tile-draining and subsoiling of the land, together with the influence which the turning under of leguminous crops has upon its physical condition and its ability to retain moisture. As rapidly as the funds available for the work will permit, the permanent improvements of the place will be provided. There is

at present great need of facilities for carrying on the work of growing plants under glass, as above noted, as well as providing areas in which to study the cultural problems connected with the development of florists' crops, such as roses, carnations, violets, etc., which can not advantageously be taken up with the work on experimental gardens and grounds.

#### RECOMMENDATIONS.

It is hoped that the facilities of the office may be so increased during the coming year as to permit taking up some of the important problems of the truck growers and florists, which up to the present time the Department has been unable to touch upon because of lack of funds and facilities for the work.

In view of the pressing necessity and demand for information in regard to the management of truck crops and the development of the trucking interests of the country, it is recommended that an appropriation of at least \$8,000 be granted to enable the Secretary to inaugurate investigations of the truck-crop interests of the United States.

The floricultural interests of the country are so widely distributed that no single State experiment station has felt justified in expending any considerable percentage of its limited income in solving the problems of the florist. The floricultural interests, too, are of such a nature that local soil and climatic conditions do not limit them as they do many other crop problems. The constant demand at this office for information in regard to the cultivation, propagation, and management of greenhouse crops renders it almost imperative that facilities be provided for investigating the many problems connected with the propagation, care, and management of greenhouse and forcing crops, as well as the construction and control of forcing structures. There is great necessity for improvement in the methods of heating and ventilating greenhouses. The coal strike of the year forced many growers to close their houses, while if suitable appliances were available for burning any one of the several cheap by-products of the oil refinery this condition might have been averted.

Because of the variety and the peculiar nature of the problems of the florists it is recommended that at least \$10,000 be appropriated to enable the Secretary of Agriculture to inaugurate investigations upon the propagation, growth, management, and improvement of florists' and forcing crops, and to erect, equip, and maintain such greenhouses or other structures as may be necessary in studying such problems, and to employ such experts, assistants, and laborers as may be required in carrying on such investigations. The more specialized character of work which each year becomes necessary in the management of the Arlington Farm demands a greater expenditure per acre under cultivation, as new and urgent problems are continually presented for solution; and in order that the work now in progress may be completed and that a few of the many new difficulties presented may each year be brought under consideration, it is respectfully recommended that at least \$25,000 be set aside for use at the Arlington Farm.

#### TEA CULTURE INVESTIGATIONS.

During the fiscal year ending June 30, 1903, the scope of the work on the growing of tea in the United States has been somewhat increased, and in order to unify the investigations they have been placed in



charge of Dr. Rodney H. True. The work at "Pinehurst," Summer-ville, S. C., in cooperation with Dr. Charles U. Shepard, has been continued. Only a small increase in the total area of land occupied by the tea plantings has taken place. This increase is devoted to new varieties that may be regarded as having an experimental interest in this part of the world. A sustained effort has been made for some years past with various shipments of tea seed from Ceylon, taken at different altitudes and stations, but with somewhat discouraging results. The plants have succumbed in large measure to the South Carolina winter. Efforts to obtain Ceylon seed from higher altitudes which will yield hardier plants have this year been in a measure successful, and a promising lot of seedlings from seeds collected at about 6,000 feet above sea level has been secured. It is hoped that these may resist the winter better, and develop in a measure the large yield of leaf of high quality characteristic of the plant in the higher parts of Ceylon. A small shipment of Formosa seed has also been received, and the future of this variety will be followed with great interest.

Experiments in irrigation and other special methods of field treatment have been carried out during the year.

In the factory, progress has been made at many points. The rotary sterilizing apparatus invented by Doctor Shepard has introduced the most satisfactory process yet devised for heating the green leaf in connection with the making of green tea. Heretofore, the satisfactory operation of the apparatus has called for the attention of two persons. Doctor Shepard has designed and put into working order a device whereby the machine is made self-feeding, demanding only the work of a boy. Other improvements in this wholly American apparatus have made it a most satisfactory piece of factory machinery. Several new varieties of other types of factory machinery, such as rolling machines, etc., have been purchased and tested with valuable results.

Of considerable interest is the experiment in compressing into tablets convenient for use the fine fragments of tea leaf broken off in picking. These tablets are prepared in a special machine of great power, the result being a firm, polished tablet which readily falls apart in boiling water.

It is known that polishing the finished tea by some form of attrition heightens the finish and raises the market value of the product. Doctor Shepard has been at work on some satisfactory means of imparting this finish, having already devised several very practicable methods.

In view of the fact that in some lands the heat of the sun is made use of in making certain sorts of tea, experiments have been made at "Pinehurst" in manufacturing a tea in part sun cured. This has given a product of very high quality, which is regarded as very desirable and one to which more attention is to be given during the coming year.

The total yield of the "Pinehurst" plantation for the last vegetative season equaled approximately the estimate of 9,000 pounds. Should an ordinarily favorable season follow, the yield for the present season will considerably exceed this amount.

For several years Doctor Shepard has kept careful records showing weather conditions at "Pinehurst," and he has compiled a report based on his records showing the relation of tea production to these as well as many other conditions of the environment. This valuable report will probably be issued later as a bulletin of the Bureau.

In accordance with the plans of last year arrangements were made for establishing a tea garden in the State of Texas, with the object of testing the possibilities of growing tea commercially in that section of the South. This garden has been located at Mackay, Wharton County, Tex., on the plantation of Mr. A. P. Borden. Imported seed of the best varieties has been obtained and planted. Seed of varieties that have done well at "Pinehurst" has been used thus far. A considerable quantity of seed was also obtained from "Pinehurst." In spite of a very unusual and trying spring season, a fine lot of young stock has been obtained for later transplantation to the field. The Texas experiment is in the care of Mr. John H. Kinsler, special agent, who has had experience in the growing of the tea plant and in the manufacturing of the finished product.

Since the beginning of the fiscal year experiments on the fermentation and curing of tea have been carried on both by Dr. Rodney H. True and Mr. W. O. Richtmann, expert in pharmacognosy. The aim of these experiments has been to ascertain the scientific basis on which these processes rest, in the hope that when these are better understood it may prove possible to improve the methods of operation. A study of the process of fermentation has shown that it is due to the activity of ferments belonging to the class known as oxidases, reacting with the tannins present in the leaf. It has seemed desirable to carry this study farther before publishing the results already obtained. Since in green tea no fermentation takes place, other processes involved in tea-making are regarded as equal in importance to that of fermentation. This investigation deals with very complicated problems and may require considerable time before practical results appear.

#### PLANS FOR FUTURE WORK.

Plans for future work at "Pinehurst" look to the development of new processes and new machinery rather than to an enlarged acreage of plants. In this direction are tests of different plans for improving the present method of fermentation. Some authorities claim that the temperature conditions prevalent during this process are of great importance in securing high quality in the product. A further improvement in the methods of making "sun-dried" tea is contemplated, together with the designing of apparatus whereby the characteristic process may be more satisfactorily carried out.

The further development of the Ceylon plants from high altitudes will be followed with great interest.

In connection with the Texas experiment, plans for the future include the transplanting of the seedlings to the field and their further care there. Since the climatic and soil conditions of Texas are quite different from those in South Carolina, many details of the experiment will have to be worked out anew or adapted to the new conditions. The labor question will probably have to be solved in a somewhat different way. Probably 100 acres of tea plants will be set out in the near future, when these new problems will have to be met.

The study of the processes of tea making as planned include an examination of the product for the substances which give it its characteristic qualities, and an attempt to ascertain their sources in the leaf and the way in which the factory processes affect these substances.

## CONGRESSIONAL SEED DISTRIBUTION AND FOREIGN SEED AND PLANT INTRODUCTION.

During the past year much has been done toward bringing the distribution of seeds and plants in closer touch with the needs of the various sections of the United States, with the State experiment stations, and with the other offices of the Bureau. The administrative work connected with the Congressional Seed Distribution and with that of Foreign Seed and Plant Introduction has been combined, making it possible to work to better advantage, since the two lines necessarily overlap to a considerable extent. Both branches of work are in charge of Mr. A. J. Pieters, who submits the accompanying report:

## NEW SEED WAREHOUSE.

Congress authorized the expenditure of \$10,000 of the last appropriation for the erection of a new seed warehouse. This was constructed during the past year at a cost of \$9,722.74. Provision was made for the addition of a third story as soon as the needs of the service should require.

## CONGRESSIONAL SEED DISTRIBUTION.

In connection with the Congressional Seed Distribution there have been two principal changes: (1) The practice of contracting for the entire work, including the seeds, has been discontinued, and the Department now purchases all the seeds directly from dealers and growers, contracting only for the purely mechanical features of the work; (2) the facilities for testing seeds and plants have been enlarged, and this will make it possible in the future to distribute seeds and plants to better advantage than before.

## METHOD OF PURCHASING SEEDS.

As stated in the report of the chief of the Bureau for 1902, the contract system was abandoned at the close of the distribution of 1901-1902, and orders were placed for such seeds as it was estimated would be needed for the following distribution. Before ordering any seed plans were prepared so that the seed best adapted to each section should be distributed in that section. The leading wholesale seedsmen were then asked for quotations on such seeds of the varieties the Department wished to use as they might have in excess of their trade requirements. After placing the orders for this surplus seed requests were sent out again for prices on growing for the Department the remainder of the seed required.

There are two important advantages to the Department in purchasing surplus seed: (1) The work of distributing can begin earlier than would be the case if dependence was placed wholly on the current year's crop; (2) the Department is to some extent relieved of danger from the fluctuations in the value of seeds due to failures of crops contracted for.

On the next page is given a statement of the number of packets of seed of all kinds put up last year, as well as of the quantities of various kinds of seeds purchased.



*Kinds of seed and number of packets and packages put up.*

Miscellaneous vegetable seeds.....	packets..	35, 000, 000
Miscellaneous vegetable seeds, novelties.....	do.....	1, 406, 250
Miscellaneous flower seeds.....	do.....	2, 500, 000
Tobacco seed.....	do.....	121, 550
Cotton seed.....	1-peck packages..	13, 500
Sorghum seed.....	1-quart packages..	9, 600
Sugar-beet seed.....	2-pound packages..	6, 000
Lawn-grass seed.....	$\frac{1}{2}$ -pound packages..	19, 500
Cowpea seed.....	2-quart packages..	4, 800
Miscellaneous seeds.....	packets.....	75, 000
Total packets and packages.....		39, 156, 200

*Quantities of seeds purchased to put up the packets and packages sent out.*

Beans.....	bushels..	5, 910 $\frac{3}{4}$
Corn.....	do.....	4, 609 $\frac{1}{2}$
Peas.....	do.....	2, 483
Beets.....	pounds..	86, 045
Cabbage.....	do.....	3, 155
Corn salad.....	do.....	5, 559
Cucumber.....	do.....	15, 921 $\frac{1}{2}$
Lettuce.....	do.....	53, 456
Muskmelon.....	do.....	2, 982
Mustard.....	do.....	546
Okra.....	do.....	6, 298
Onion.....	do.....	7, 517
Parsnip.....	do.....	8, 970
Radish.....	do.....	83, 212
Spinach.....	do.....	12, 762
Squash.....	do.....	4, 017 $\frac{1}{2}$
Tomato.....	do.....	9, 055 $\frac{1}{2}$
Turnip.....	do.....	7, 100
Watermelon.....	do.....	41, 033 $\frac{1}{2}$
Flower seeds.....	do.....	15, 511 $\frac{3}{4}$
Sugar-beet seed.....	bushels..	10, 000
Cotton seed.....	do.....	2, 800
Tobacco seed.....	pounds..	412
Lawn-grass seed.....	do.....	9, 000
Sorghum seed.....	bushels..	300
Cowpeas.....	do.....	300
Miscellaneous grains, forage-crop, and other seeds; estimated.....	pounds..	100, 000

Total weight of seeds of all kinds put up during the year, about,  
pounds..... 1, 331, 500

At the close of the distribution a number of packages and packets remained undistributed. These will be used during the coming year so far as the seed remains good. Many of these loose packets of valuable varieties were also assembled into special sets to be distributed to schools or on such special requests as may seem to justify more than the usual number of packets.

*Seeds in packages and packets left at the close of the distribution.*

Packages of vegetable seed.....	208, 200
Packages of flower seeds (school sets).....	44, 700
Loose packets, vegetable seeds.....	640, 067
Loose packets, flower seeds.....	56, 094

The trees, plants, and bulbs required for the distribution were ordered by the Horticulturist in accordance with plans prepared by himself. The number of each purchased and sent out during the year is as follows:

Trees (shade).....	40, 402
Grapevines.....	22, 500
Strawberry plants.....	75, 000
Bulbs.....	174, 000

The work of packeting, assembling, and mailing the vegetable and flower seeds was done by the Brown Bag-Filling Machine Company, of Fitchburg, Mass., under a contract by which the Department controlled the rate at which seeds should be packeted and the daily output of seeds mailed. All the special seeds distributed were handled, as usual, by our own force.

The appropriation for the purchase and distribution of valuable seeds and plants was \$270,000, which was expended as shown in the following statement:

*Expenditures for the purchase and distribution of seed.*

Salaries .....	\$42, 823. 03
Salaries outside of city .....	1, 714. 93
Foreign Seed and Plant Introduction (exclusive of salaries) .....	17, 262. 90
Traveling expenses .....	3, 741. 43
Miscellaneous authorizations .....	2, 635. 81
New seed warehouse .....	9, 722. 74
Brown Bag-Filling Machine Company (contract) .....	48, 879. 05
Brown Bag-Filling Machine Company (purchase of surplus bags) .....	1, 649. 00
Miscellaneous expenses .....	16, 160. 64
Vegetable and flower seeds .....	101, 187. 57
Tobacco seed .....	694. 75
Miscellaneous plants .....	2, 205. 53
Cotton seed .....	2, 343. 25
Sugar-beet seed .....	1, 110. 27
Lawn-grass seed .....	792. 95
Sorghum seed .....	550. 00
Miscellaneous seed .....	3, 832. 67
Trees .....	773. 45
Bulbs .....	3, 708. 80
Strawberry plants .....	244. 00
Grapevines .....	938. 19
Raspberries, gooseberries, and currants .....	56. 90
	<hr/>
Balance .....	263, 047. 86
	<hr/>
Total .....	270, 000. 00

The enormous quantity of seed required for the regular distribution makes it impossible to use seed of new and rare varieties, because such seed is not on the market in sufficient quantity. An effort was made, however, to provide for such distribution by purchasing limited quantities of seed of varieties either relatively new or special strains of well-known sorts. The distribution of this seed was made special. In the regular distribution our efforts were chiefly directed toward providing seed of such standard sorts as gave reasonable assurance of success to the planter in order that the practice of gardening might be encouraged by reason of the success achieved. We are confident that success with such a small garden as is made possible by a collection of Congressional seed will result in a demand for a greater variety of seed in order to have a larger garden, and that this demand will cause increased business for the seed trade.

TESTING GARDENS.

In our study of the varieties of vegetables best adapted to the different sections of the United States it soon became evident that not enough is known about the characteristics of varieties to enable us to make the best possible selections. The nomenclature of varieties is much mixed, and the effect of varying climatic and soil conditions on

varieties is but imperfectly understood. Arrangements were therefore made for work on this important subject, and in February we secured the services of Mr. W. W. Tracy, sr., to carry on this work. The first thing necessary was to arrive at a more definite conception of what the leading varieties are, and arrangements were made with the agricultural experiment stations of Maine, South Dakota, and Nebraska to make plantings of and to take notes on the varieties in accordance with a plan formulated by Mr. Tracy. Several of the leading seed growers have also been interested and are cooperating with us in this work. As a result, trials of cucumbers, beans, peas, corn, and cabbage have been undertaken in New York State, Michigan, Maine, South Dakota, and Nebraska. Many of the leading seedsmen have expressed their appreciation of the importance of this work and of the Department's efforts in this direction. The results of the work can not, of course, be given until the close of the season, but Mr. Tracy has found, by a study of the experiment station literature, that while many tests of varieties have been made, the work has not been done on a uniform plan and has often been rendered fruitless by the use of seed incorrectly named.

#### INSPECTION OF CROPS.

The inspection of seed crops grown by the Department is of great importance in insuring the delivery of good seed, as well as in keeping the Department informed regarding the prospect of deliveries. During the past year two representatives of the Bureau were sent out to inspect crops, and they were also instructed to make such notes and observations on the seed industry as might be possible. Their reports are on file in this office and are valuable documents for reference.

#### DISTRIBUTION OF SPECIAL SEEDS.

**COTTON SEED.**—The distribution of cotton seed was conducted with the cooperation of Dr. H. J. Webber, who recommended the varieties selected as being of special merit. In addition to the usual amount, 150 bushels of King cotton seed were purchased and sent to the boll-weevil districts of Texas, where it was thought that this early variety might make a crop while other sorts failed.

The Sea Island cotton seed purchased was the wilt-resistant strain developed under the direction of the Pathologist, the seed being secured from the originator of the variety.

**TOBACCO SEED.**—Through the cooperation of the Bureau of Soils, the fields on which seed of most of the varieties of tobacco distributed were being grown were examined by an expert and the mother plants pronounced true to name and of good type. It is certain therefore, that the tobacco seed distributed was of good quality.

**IRON COWPEA.**—Three hundred bushels of Iron cowpea, which is resistant to both wilt and root-knot, were purchased and distributed in the districts affected with these diseases.

**SUGAR-BEET SEED.**—To encourage the commercial production of sugar-beet seed, which is also the subject of special work, as mentioned elsewhere, we purchased and distributed 10,000 pounds of American-grown seed. Some of this seed was sent in 100-pound lots



to representative factories, and arrangements have been made to secure reports. Reports made last fall on seed produced by the same grower during the previous year showed that the seed was fully equal to the best imported seed, and was superior to that commonly used in the United States.

#### SPECIAL DISTRIBUTION OF FORAGE-CROP SEEDS.

During the past year many letters were received from persons who wished to develop the agricultural possibilities of new regions, requesting the aid of the Department through the distribution of seeds. The importance of giving proper encouragement to such efforts was recognized, and frequently, acting on the advice of the Agrostologist, seeds of various forage plants were sent to such applicants. A record is kept of seeds thus distributed, and reports will be called for in due time.

#### SEED GROWING.

Because of the large amounts of seeds annually distributed, we are especially interested in the seed-growing industry, and work has been begun looking toward the solution of some of the problems connected with seed growing.

#### SUGAR-BEET SEED GROWING.

The importance of the domestic production of a high-grade seed for the healthy development of the beet-sugar industry in the United States is well recognized. The amount of sugar-beet seed used in this country is estimated at 2,400 tons annually, and no good reason seems to exist for not producing this seed ourselves. During the past year the preliminary work of raising high-grade sugar-beet seed in different parts of the United States was begun. In cooperation with the experiment stations in New York (Geneva), Michigan, Illinois, and Colorado, seed of several strains was planted and selections of mother beets made last fall. For various reasons this work was then discontinued in Illinois and Colorado, but was resumed in New York and Michigan. The beets that had been siloed were tested, and those selected for planting were marked and set out. These individual mothers will be the starting points for strains of pedigree seed. Work of this kind was also carried on in Washington State in cooperation with a seed grower, and assistance was rendered by the chemist of the Washington experiment station, who made the analysis of the beets.

The results obtained during this one season justify the belief that high-grade seed can be grown in the United States. The work will be actively carried on in the future.

#### CAULIFLOWER SEED GROWING.

With the exception of a limited amount of seed grown in the Pacific Northwest, all the cauliflower seed used in the United States is produced abroad and brings a high price in this country, as much as \$3.50 per ounce being willingly paid for good seed.

In order to test the possibility of growing this seed in the Eastern United States, a cloth shade was erected on the land of a Long Island cabbage-seed grower, and arrangements were made with him for the care of the plants. Owing to the appearance of a disease, no results

were obtained last year, but much was learned that will make success probable this year. This work is still under way.

#### PLANS FOR CURRENT WORK.

The plans for the Congressional distribution during the current year contemplate the distribution of 31,958,240 packets of vegetable seed and 4,000,000 packets of flower seed, although the number of the latter may be somewhat increased.

The tree, plant, and bulb distribution will be carried on along essentially the same lines as last year, with such changes in detail as have been found advisable.

In the distribution of special seed the principle of cooperation with other offices of the Bureau will be further carried out. In accordance with cooperative arrangements between this office and that of the Pathologist of the Bureau, contracts have been made for growing 15 acres of resistant cottons besides the Sea Island cotton seed distributed last year. These varieties have been developed under the direction of the Pathologist, and in order to insure their wide distribution, considerable quantities of seed will be produced. The fields are under the charge of the Pathologist, and will be carefully rogued to preserve a high standard. In case only a small amount of seed should be produced this will be reserved for stock seed to be used for the following year, but if a good crop results some seed will be available for distribution during the current year.

Contracts similar to the above have been entered into for growing seed of the new varieties developed through the work of the Plant-Breeding Laboratory. These contracts cover the growing of 16 acres of cotton.

Seed of a wilt-resistant strain of watermelon is also being grown under the supervision of the Pathologist. This line of cooperative work will be pushed, as it is thought much good may be accomplished by making available through the seed distribution the practical results of the scientific investigations of the Bureau.

**TOBACCO SEED.**—The tobacco-seed crop will again be examined by an expert from the Bureau of Soils. This has already been done in the case of a special crop of Sumatra seed being grown from imported stock. The leaf raised from the seed is reported to be of specially fine stock, and by a careful selection of the best plants we shall secure an exceedingly choice lot of seed for distribution.

#### SPECIAL WORK.

**SUGAR-BEET SEED GROWING.**—This work is being carried on as planned last year. Fields are planted at Geneva, N. Y., Lansing, Mich., and Fairfield, Wash. The work has also been commenced in cooperation with the Utah experiment station.

**CAULIFLOWER SEED GROWING.**—This work gives promise of a successful issue this year, though the season has not been favorable to a satisfactory test of the value of shade.

**COOPERATIVE TESTING GROUNDS.**—The work is being carried on by Mr. W. W. Tracy, sr., as mapped out last year. Trials are in progress in New York State, Michigan, Maine, South Dakota, and Nebraska,

as already mentioned, and Mr. Tracy will, in the course of the summer, visit a number of the experiment stations in order to arrange for an extension of this work.

**CROP INSPECTION.**—So far as possible all of our crops will be inspected. Unfortunately, there is not a sufficiently large force of experts so that all crops can be inspected at the proper time, but some young men are being trained for this work. The great need of this office at present is for men who can take a responsible part in the Congressional distribution during the winter and assist in the testing and crop-inspection work during the summer. Such a force will have to be trained, and may gradually supersede a part of the present clerical force.

#### TESTING AND DEMONSTRATION FARMS.

During the present year the Agrostologist of the Bureau is cooperating with this office in establishing, under the direction of Dr. S. A. Knapp, a series of testing and demonstration farms in the Gulf States. These farms will be used to test both domestic and imported varieties, the work of testing seeds and plants for Congressional distribution being thus combined with that of testing those imported through the office of Foreign Seed and Plant Introduction. The study of at least four typical conditions is at present engaging attention.

**RICE WORK.**—This work, begun a few years ago by the introduction of Japanese rice, has been continued in order to more fully test the different varieties, to select and propagate the best seed for distribution, and to solve a number of problems in rice culture in order to render timely assistance to a growing industry. How rapidly this has grown will be appreciated from the fact that while a few years ago there was little or no rice grown in Texas, the acreage for the present year is estimated at 235,000 acres. Not only has a new industry been established, but the land has increased greatly in value, thus adding thousands of dollars to the wealth of the State.

The farm that has been established to care for the rice interests will also prove useful for testing other crops that may be adapted to the conditions prevailing in the prairie belt through the great West. It was found necessary toward the close of last year to find a better location for this work, because the soil was not strong enough. In the future this work will be carried on at North Galveston, Tex., where most satisfactory facilities were secured.

**SEMIARID DISTRICT.**—There are in Texas alone thousands of acres of fertile land capable of producing large crops in a year of heavy rainfall, or where irrigation can be practiced. Normally, however, the rainfall is not sufficient to make a crop of corn or of cotton, nor is irrigation practicable save to a limited extent. The problem as to what plants will thrive under semiarid conditions and can be converted into money, either directly or through live stock, is a very important one. This the Department has taken up by establishing a small experimental farm on typical land within this region. It is proposed here to test such plants, both foreign and domestic, as may give promise of proving of value, and to demonstrate, if possible, that the homeseeker can make a living on 80 acres of semiarid land.

**FERTILE BUT WORN-OUT UPLANDS.**—Throughout the South the constant cropping of corn and cotton has greatly depleted the land.



Renovating crops are needed, and also crops that may be grown for their money value to take the place of the staples formerly raised. In order to more effectively test the value of crops, both foreign and domestic, for these conditions, and to demonstrate improved methods of cultivation, the Department has entered into cooperative arrangements with owners of land in Louisiana and Texas by which these persons are to carry out the plans and follow the instructions given by the Department, and the Department is to assist in defraying certain of the expenses of the experiments.

**PINE-WOODS REGION.**—Covering more than 100,000 square miles of territory, and stretching from eastern Texas through Louisiana, Mississippi, Alabama, and Georgia, is a belt of pine forest. The soil of this belt is mostly thin and sandy, with a hard clay subsoil lying at a depth of from 2 to 3 feet. When the pine is cut from these lands they are practically worthless. The soil is too poorly drained to permit of the satisfactory growth of the ordinary farm crops. A small farm will be established this fall on land of this character in order to test crops that may be adapted to such conditions.

#### FOREIGN SEED AND PLANT INTRODUCTION.

##### FOREIGN EXPLORATIONS.

During the past fiscal year five parties of agricultural explorers have been sent into foreign parts, and besides this Hon. Barbour Lathrop has continued to send plants and seeds collected by himself and Mr. D. G. Fairchild.

One agricultural explorer was sent to Turkestan to secure another consignment of alfalfa seed. A party of two, consisting of one member of the scientific staff of the Bureau of Plant Industry and one from the Bureau of Soils, was sent to Algeria and to Egypt in order to find a strain of alfalfa resistant to a larger percentage of alkali in the soil than our common variety will endure, as well as to secure seed of other alkali-resistant crops. A third party was sent to Jamaica to examine and report upon a collection of cassava plants, with a view to the purchase of the collection and the introduction of these varieties. The fourth expedition went to Mexico in search of varieties of peaches, apricots, and cherries thought to possess advantages over those at present in use, while the fifth explorer, Prof. H. L. Bolley, of the North Dakota experiment station, was commissioned to study flax in European countries, with a view to bringing back select varieties. Professor Bolley is still abroad.

The results of the explorations undertaken last year have proved very satisfactory, seeds and plants of many new and valuable varieties having been secured. A report, giving the results of his observations, has been prepared by each explorer, or such report is in preparation, and it is the intention to publish those reports that prove of general interest. The results of the expedition to Algeria and Egypt have already been partially reported upon in a Yearbook article by Messrs. Kearney and Means and in a bulletin of the Bureau of Soils by Mr. Means. Results of great importance to farmers on the alkali soils of the West were secured, and the Bureau of Soils is now putting into operation some of the principles learned by Mr. Means. It was learned that several crops that were reported as growing on salty lands in the Nile delta are not alkali resistant, but are merely shallow-

rooted plants that grow in the ground after it has been washed free from salts.

**TURKESTAN ALFALFA.**—Mr. Ernst A. Bessey was sent to Russia and to Turkestan to secure seeds and plants, especially seed of the hardy alfalfas of Turkestan. He found four principal types of regions in which this alfalfa was growing, and secured seed from each locality, amounting in all to about 5,000 pounds. Some of this seed was collected in regions of hot, dry summers and very cold winters, thus representing great extremes of temperature; some from places where the summers are hot but the winters mild; a third lot from the mountainous region, where the winters are cold but the summers mild; and, lastly, a small lot of seed was secured from Bokhara, where the soil is strongly alkaline. The seed secured by Mr. Bessey has been carefully distributed to persons agreeing to plant it for seed purposes, the Department to have the first option on the seed produced.

The previous importation of Turkestan alfalfa seed by the Department failed to establish the variety in the United States because no seed had been raised. As a result of last year's importation more than 100 contracts have been entered into with persons who have planted the seed according to instructions from the Department, and who will harvest the seed and sell it to the Department for future distribution. The reports in regard to the success of the plantings made have so far been most encouraging. In one case, where the seed was planted in Vermont the past spring, a second cutting of hay was made during the latter part of July, and some of the plants were  $3\frac{1}{2}$  feet high at that time.

**ALKALI-RESISTANT ALFALFA.**—One hundred pounds of seed of an alfalfa growing in soil containing as high as 1 per cent of alkali was secured in Algeria. If this alfalfa will do as well under the conditions prevailing in the Southwest as it does in Algeria, it will be possible to grow alfalfa on thousands of acres too alkaline to permit the common alfalfa to thrive. This will be of immense importance to the Southwest, and every possible care has been taken to test the seed secured and at the same time to grow seed for further distribution if the variety proves useful. Mr. Bessey also found an alfalfa growing in very alkaline soil near Bokhara, and obtained seed which has been planted so that the Department may secure a seed crop if the planting proves successful.

**CEREALS.**—During the past year the importation of grains was continued under the direction of the Cerealists of the Department, and a report on the cereal work has already been made by the Pathologist and Physiologist.

The work on the introduced grains is the most important single line of plant introduction yet undertaken, and has naturally been carried on in close cooperation with the Pathologist and Physiologist of the Bureau.

The methods pursued during the past year have remained the same as those described in the last report of the chief of the Bureau. These methods have been found eminently satisfactory, and the principle involved of careful tests on a small scale before making a large importation is being applied to other lines of plant-introduction work.

The cereal work of the past year was largely concerned with the establishment of macaroni wheats in Texas and South Dakota, the

extension northward of the winter-wheat districts by the introduction of Russian varieties, and the testing of the varieties of small grain referred to in the report of last year. Among the importations of the year were two special lots of macaroni wheat, one of rust-resistant varieties from Bombay and one of Saragolla wheat from Italy. The latter, for which the Department has to thank Mr. Lathrop, has been described by Mr. D. G. Fairchild, in a brief publication of the Bureau, as the best of the wheats for the manufacture of macaroni. All the seed has been distributed in the macaroni wheat belt.

Several hundred bushels of Russian winter wheats, of varieties that had given good results during the preceding year, were purchased, besides 60 bushels of wheat that, while not of the best quality, yielded two crops a year on the same land, and may thus prove of value in certain places.

A small quantity of Hanna barley, which was introduced by the Department some time ago, was purchased in order to further extend the distribution of this valuable variety.

**MALAKHOV SUGAR CORN.**—Seed of this early sugar corn was introduced some years ago by Professor Hansen and was again brought to this country by Mr. M. A. Carleton. As a result of the first distribution the variety has already found its way into the seed catalogues, but the stock is not uniform, and more work is needed before it can be sent out as a variety with well fixed characteristics. The work of fixing the desirable characteristics is being carried on in connection with the Congressional distribution work, and the seed will be used in that distribution as soon as the variety is ready to send out.

**DUTCH BULBS.**—All of the many thousands of Dutch bulbs sold in the United States are imported, and it is believed that this industry can be established in some part of this country. With our varied climatic and soil conditions it is surely possible to duplicate any conditions that may exist in other temperate countries. A partial success has already been attained in Washington State, where bulbs in limited quantities have been grown for some years. An importation of a number of bulbs of the best sorts will be made for propagation, and every encouragement will be given to this industry.

**CASSAVA.**—Our agent, Prof. P. H. Rolfs, sent to Jamaica to examine the collection of cassavas offered for sale, reported that it contained many very superior varieties, several having 33 to 36.5 per cent of starch, as compared with 25 per cent in the variety commonly grown in this country. The collection was therefore purchased and planted at the Department gardens in Florida. Cassava has already won a distinct place for itself as a cattle and hog feed in the extreme South, but the varieties in use at present are not uniform in production, nor of the best quality. It is hoped that some of the new varieties will give a more uniform yield and thus larger returns per acre.

**FLAX VARIETIES.**—During 1901 the State of North Dakota alone produced 13,000,000 bushels of flaxseed, worth \$19,460,000. To this large industry must be added the possibility of using the fiber of the flax grown in the Northwest for the manufacture of binder twine and other purposes. This use of the fiber is of recent introduction, but promises to become an important secondary industry.

There is much need of improvement, however, in the varieties as



to uniformity of ripening, hardness, yield, quality of fiber, and freedom from disease. In order to foster this industry and to secure the best varieties in existence, an agent, Prof. H. L. Bolley, was sent during the latter part of the past fiscal year to study the flax question in Europe and to get seed of good varieties. He will remain abroad for a portion of the present fiscal year.

**MEXICAN APRICOTS.**—On the occasion of Mr. G. Onderdonk's former expedition to Mexico in search of hardy peaches for the South, he learned that there were several varieties of apricots not only of superior vigor and longevity, but also producing fruit of good quality. Buds of these varieties were sent to America at that time, but failed because the season for such work was not right. It was thought best, therefore, to send Mr. Onderdonk to Mexico again during the latter part of the past fiscal year in order to collect buds of these varieties at the time the trees were in fruit, so that no mistake should be made in the identity of the trees. The buds collected by Mr. Onderdonk were sent to a nurseryman in Florida, who succeeded in establishing some of nearly every variety.

**DATE GARDEN.**—The date garden in Arizona was visited during the past year by the botanist in charge of Seed and Plant Introduction and Distribution and was found to be in a thriving condition. Two of the varieties, the Rhars and the Deglet Noor, were in fruit. The suckers have not attained sufficient size for removal, but it is hoped that by another year a small number of suckers will be available for distribution.

The Colorado Desert region was visited with a view to making arrangements for planting a small commercial orchard which should be in a measure under the control of the Department. This desert is particularly well adapted to the culture of the date, and an orchard should be established there as soon as possible.

**RICE WORK.**—During the year 41 varieties of rice were tested on the Department rice farm in Louisiana. With few exceptions these rices were imported from China and Japan. As a result of the year's work, the Department had available for further distribution 30,000 pounds of seed of several varieties. This seed was distributed in the rice region of the Southwest.

The tests of the varieties grown by the Department served to eliminate many of the kinds tried as being inferior; these were accordingly discarded. The yield from several varieties was, however, markedly better than the average yield secured in the vicinity of the farm. A very important result of the work was the evidence that the season of harvesting may be extended by the use of suitable varieties. One man can plant and irrigate a larger acreage than he can harvest, without serious loss from overripening and shattering, but all attempts made to extend the period of ripening by sowing the seed of one variety at different times have failed because each variety matures at practically the same time, whether the seed is sown early or late.

By the use of suitable varieties, however, such as have been imported and tested by the Department, the period of growth may be extended from one hundred and three to one hundred and thirty-eight and one hundred and fifty-two days, making it possible to sow all varieties at about the same time and to harvest as the different sorts ripen, without haste and without loss.

Experiments were also made on the effect of fertilizers in increasing the production of rice, and it was found that an application of raw bone, acid phosphate, and lime increased the yield 50 to 100 per cent.

**RESISTANT GRAPEVINES.**—The securing of grapevine stocks resistant to phylloxera, as well as to other diseases of the vine in California, and that shall be congenial to the best commercial varieties, while also adapted to the different soil conditions prevailing, is recognized as being a matter of the greatest importance. Several types of resistant stocks have been developed abroad, and these have been imported from time to time without any definite results being obtained. During the past year a plan of cooperation was agreed upon between this office and the office of the Pomologist of the Bureau, and between the Bureau and the California experiment station, by which a systematic test should be made of the resistance, adaptability, and congeniality of stocks. As a result of this agreement, this office has established and maintained two vineyards in California, which have been placed under the direction of the Viticulturist of the Bureau.

**JAPANESE BAMBOOS.**—About 1,500 bamboo plants of several varieties, including the large timber bamboos, were sent to the Department by the Hon. Barbour Lathrop and distributed throughout the South and West. Unfortunately, many of these have died because of unfavorable conditions, but it is thought that enough will become established to make a beginning of the culture of bamboos in the United States. A bulletin on the Japanese bamboos, prepared by Mr. D. G. Fairchild, has been issued by the Department.

**SUMATRA TOBACCO SEED.**—The growers of Sumatra leaf tobacco are compelled from time to time to make fresh importations of seed direct from the Dutch East Indies, and it is always difficult to get first-class seed. During the past year about 6 ounces of genuine Sumatra seed were secured by the Department through the enterprise of Hon. Barbour Lathrop, and distributed through the cooperation of the Bureau of Soils. Arrangements were made at the same time by which the Department would have an option on a quantity of the seed produced from the plants raised. Seed raised from the first generation of plants in this country is nearly if not quite equal to the imported seed, and our seed will be saved from the most carefully selected plants.

**THE MANGO.**—The mango is rapidly increasing in popular favor in the South. Especially is this the case since one or two of the celebrated Indian varieties came into bearing in Florida. There is now an urgent demand for these and other varieties, for the purpose of budding and grafting on the inferior fruited seedling trees common over a large tract of southern Florida. Several private concerns have attempted the importation of plants from India at great cost, but owing to the poor facilities for securing suitable plants of good varieties and insuring quick and safe transportation to the United States nearly all of the plants died before reaching their destination. The Department, through its agents abroad, secured last year about 50 of the best varieties from India. These plants are now in excellent condition. Some of them are growing in the Department gardens in southern Florida, but the most of them are being propagated in the greenhouses at Washington, D. C. Specimens of each variety will be sent to the mango districts in Florida in the near future.

In connection with the introduction of the finer varieties of mango into Florida, it has been found that the question of propagation is a serious one, greater skill being necessary in the work than is required for such plants as the orange and other citrous fruits. The question has been thoroughly studied and good results achieved. Information dealing with the best methods of propagation has recently been published as Bulletin No. 46 of the Bureau of Plant Industry.

**LOQUATS.**—Several of the best varieties of loquat, or Japan medlar, have recently been secured from China, Japan, and the Mediterranean region. Some of these have already fruited in the green-houses of the Department and their superior qualities have been demonstrated. In this case, as in that of the mango, the different methods of propagation have been thoroughly tested, and information on this line of work, embodying some easily applied methods, is available to those contemplating the cultivation of the loquat.

**A COVER CROP FOR CALIFORNIA ORCHARDS.**—During the past year gratifying progress has been made in solving the problem of a good cover crop for orchards in the irrigated districts of California. The practice of continuous cultivation of orchards has gradually reduced the humus in the soil, and the effect of this loss is being felt. To restore the humus, a winter cover crop is wanted that can be readily turned under. Some of the vetches answer well, except that they mat together so that it is well-nigh impossible to turn the mass under.

In cooperation with the California experiment station, this office distributed 1,200 pounds of fenugreek seed, which had given promise of success in a preliminary test the previous year. The reports received seem to show that in many places the trial was eminently successful.

#### MISCELLANEOUS IMPORTATIONS.

A number of minor importations was made, which may be briefly mentioned:

A quantity of cork-oak acorns for planting in California, where it is believed the cork industry may succeed; 100 pounds of various kinds of Mexican beans, which have been distributed in the South and Southwest; seed of several strains of flax for testing in Oregon, where it is thought a superior fiber can be produced; sand-binding grasses and various forage crops from South Africa and Turkestan. These are being tested by the Agrostologist, and further importations will be made of such as prove desirable.

From South Africa has also been received a number of sets of a new variety of pineapple, which, though small, is said to be of superior quality. These sets have been planted in the Department propagating houses in order to watch for any insect or fungous diseases that may appear. A hardy grape that promises well as a stock was also sent by Hon. Barbour Lathrop from South Africa. These South African importations are described in a paper by Mr. D. G. Fairchild which has been published as part of Bulletin No. 25 of the Bureau.

From Egypt we have secured an additional importation of seed of the best varieties of Egyptian cotton. This seed has been placed at the disposal of the Plant-Breeding Laboratory for further work on the production of improved varieties of cotton.

From Japan we have a new horse-radish, a new salad plant, and the



Japanese paper plant. These importations have all been described by Mr. Fairchild in a bulletin entitled "Three new plant introductions from Japan." There has also been received a collection of the beautiful Japanese flowering cherries, which have been distributed to those who could give them the proper attention.

This office has also imported a number of mulberry trees for the use of the Entomologist in pursuing his work on silkworm culture. A bulletin, by Mr. George W. Oliver, on the cultivation and propagation of silkworm food plants, has been issued by the Bureau.

#### PLANS FOR CURRENT WORK.

For some time it has been evident that the facilities for the care and distribution of importations have not kept pace with the quantities of seeds and plants imported. Many valuable importations have been lost because of this defect in the system of work, and others have fallen into the hands of persons who are exploiting the varieties for their own advantage. During the present year an effort will be made to remedy this, and more attention will be paid to the work within the United States.

**PLANT INTRODUCTION GARDEN.**—Each year the limited facilities for caring for collections of economic plants on the Department grounds and in the greenhouses have become more and more inadequate to properly handle the large number of plants sent in by the Department explorers.

This has, in many cases, resulted in the loss of valuable material or in a hasty distribution, ending either in the loss of plants or in sending them to places where they were not well cared for.

It has also been found that very few people are qualified to make a thorough test and give a reliable report upon plants sent them. A list of competent experimenters must, of course, be an important feature of this work, but such a list will of necessity be of slow growth, and meanwhile the Department must depend upon its own experts for a decision in regard to the value of any variety. Such a decision can only be based upon an examination of adequate material properly grown and cared for under favorable conditions.

The necessity for such a garden having become imperative, it was decided to establish one in California, in which State conditions may be found under which plants of temperate and subtropical climates may thrive throughout the year. This garden will be maintained by the cooperation of the Pathologist and Physiologist with this office for the general advantage of the Bureau, and will be conducted in cooperation with the California experiment station. In it will be collected all the economic plants that are introduced by the Department, and this collection will in time become of great value for the scientific work of the Bureau. The varieties introduced will be tested and those really superior will be propagated for further distribution. The garden will also become the central point from which the Department will work for the establishment of new plant industries.

**CEREALS.**—In line with the determination to spend more effort on establishing introduced varieties, the facilities for field work in the West will be increased, so that definite results may be secured regarding promising varieties. This work will be carried on in Texas, South

Dakota, Idaho, and Nebraska, and will, as usual, be under the direction of the Cerealists.

**FOREIGN EXPLORATIONS.**—At the present time three explorers are in the foreign field for the Department.

Professor Bolley is continuing his investigations on the flax industry, and will bring back seed of varieties raised in different provinces of Russia.

Mr. J. E. W. Tracy is studying the growing of sugar-beet seed in Europe in order to better direct the work in this country.

Mr. Ernst A. Bessey is making an exploration of the Caucasus region, in which may be found the wild types of several of our cultivated nuts and fruits. It is hoped that several hardier varieties may be secured in this way.

Plans have also been perfected for sending Dr. George T. Moore to Europe to secure cultures of important nitrifying organisms. This work will be done in cooperation with the Pathologist and Physiologist.

**DATE INTRODUCTION.**—The introduction of date culture into America will be pushed, especially in the Colorado Desert region, where an orchard of the best commercial varieties will be established. This work will be done in cooperation with the California experiment station.

**BERSEEM.**—In cooperation with the Agrostologist, a systematic effort is being made to test the value of berseem in the United States. Plantings will be made in various places throughout the South under a variety of conditions, and these plantings will be visited by an agent of the Department. The Laboratory of Plant Physiology will supply the tubercle organisms, so that all the conditions will be favorable for a thorough test.

**RESISTANT-VINE WORK.**—This work will be extended by enlarging the facilities at the vineyards already established, by instituting small branch vineyards for testing the leading sorts on different soils, and by importing such new varieties as may seem worthy of trial.

**RICE WORK.**—The rice work is being taken up this year on stronger land in the great rice region of Texas. The best of the varieties tested last year will be tested again, and pure seed of the best quality will be grown for distribution in the rice belt.

The Department will also be in a position to undertake further experimental work on rice growing.

**STUDY OF COMPARATIVE CLIMATIC AND SOIL CONDITIONS.**—Two things are necessary to the successful introduction of new plant industries. On the one hand the conditions necessary to the healthy growth and fruiting of the plant must be known, and on the other hand it must be possible to select such localities in the United States as present these conditions. The selection of each locality will depend not so much on mean annual temperatures or mean rainfall as upon the extremes of climatic conditions and the seasons of the year during which such extremes occur.

The profitable cultivation of the almond is impossible in many places because frost is likely to kill the blossoms, and the date palm will thrive in many places, but will mature fruit only where the summer temperature is high and the air dry.

The character of the soil is no less important than the geological features, the facilities for irrigation, the distance from markets, and many other minor elements that have an influence on the successful introduction of any plant industry.

It is planned this year to begin work on the systematic collection of such data to be taken from already existing sources so far as practicable, and to compile these data and express them on maps and charts in order that more complete information in regard to these conditions may be available in this office. This work is considered to lie at the foundation of plant introduction and should be put into more satisfactory shape before further extensive explorations are carried on.





## REPORT OF THE CHEMIST.

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U. S. DEPARTMENT OF AGRICULTURE,  
BUREAU OF CHEMISTRY,  
*Washington, D. C., September 8, 1903.*

SIR: I have the honor to submit herewith my report of the operations of the Bureau of Chemistry for the fiscal year ended June 30, 1903, together with an outline of the proposed work for the fiscal year ending June 30, 1904, and an estimate of the probable expenses of the Bureau for the fiscal year ending June 30, 1905.

Respectfully,

H. W. WILEY, *Chemist.*

Hon. JAMES WILSON, *Secretary.*

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### WORK OF THE YEAR, WITH RECOMMENDATIONS.

The year just ended has been the most active of any in the history of this office.

#### NEW INVESTIGATIONS.

##### TABLE SIRUP FROM ORDINARY SUGAR-PRODUCING PLANTS.

Two important additions were made to the investigations of the Bureau during the year. One of these was the investigation of the methods of making a better table sirup from the ordinary sugar-producing plants, such as the maple tree, sorghum, and sugar cane. Investigations carried on some years ago by the Division of Chemistry showed that table sirups were generally adulterated; in other words, they were not produced exclusively by the clarification and concentration of sugar-bearing juices. Testimony taken before the committees of the House and Senate charged with investigating food adulteration elicited the fact that it was a common practice to manufacture maple sirup of ingredients corresponding to the price which the purchaser wished to pay. If he were willing to pay the high price of \$1 or \$1.25 per gallon, he would be provided with the pure article. If he could pay only 30 cents a gallon, he would get a maple sirup which contained practically none of the pure maple product. Glucose—that is, the water-white, thick, sirupy liquid made from the partial conversion of starch into sugar and the purification and concentration of the product—is a very common material used as a basis for table sirups. The result of all this sophistication and adulteration has been to depress the price of the genuine articles to a point which renders their profitable manufacture problematical.

The object of our investigations was to determine the methods in vogue in the manufacture of table sirups and to ascertain, by analysis

or experiment, methods whereby the product could be made better, of a more pleasing appearance, with less tendency to crystallization, and have a greater resistance to fermentative processes. The experiments were conducted chiefly with sugar cane in Georgia, Alabama, Mississippi, and Florida. A considerable amount of experimental work was, however, done with sorghum in Minnesota and Kansas.

The agricultural work connected with the investigations consisted in studying the methods of fertilizing and cultivating sugar cane in order to secure the highest financial returns. These experiments were conducted in different localities, mostly in those mentioned above, and particularly at Cairo, Ga. With the collaboration of Mr. W. B. Roddenbery, of that place, an elaborate series of experiments was conducted which will prove of the utmost benefit in practice. A full detailed account of these experiments is found in Bulletin No. 75 of the Bureau of Chemistry.

The manufacturing data connected with the investigation have not yet been tabulated, but will be soon published in a separate bulletin. This bulletin will contain a statement relating to the ordinary methods of manufacturing and will deal particularly with the experimental work conducted through the courtesy of Mr. J. T. Wells at his factory at Guyton, Ga. A further reference to this subject will be found in the part of this report dealing with the activity of the sugar laboratory.

#### EFFECT OF PRESERVATIVES AND COLORING MATTER UPON HEALTH.

The other important addition to the work of the Bureau was the beginning of the experimental study of the effect of preservatives and coloring matters upon digestion and health. This work was especially authorized by Congress for the purpose of reaching, if possible, definite conclusions on many disputed points. Experts of high character have in great numbers declared for the wholesomeness, or at least innocuousness, of many common preservatives. On the other hand, experts equally as renowned and working apparently with as great care have reached conclusions of an opposite character. Since the law authorizes the Secretary of the Treasury to exclude from the ports of the United States food products to which any injurious substance has been added, it is highly important, in order to properly execute the law, that these differences of opinion be investigated and a wise and just conclusion reached. It was to this end, as well as for the general benefit of the public, and for the information of manufacturers, that the elaborate experiments to determine these matters were inaugurated. The organization of the experimental work is here given.

In arranging for the experiments, in carrying them out, and in discussing the data, an earnest effort was made to put aside every theory or personal impression or prejudice connected with the subject. The object in view has been solely to ascertain the facts, to establish them if possible beyond cavil, to collate them in what seems a scientific and reasonable manner, and at the end to draw such conclusions as judgment, uninfluenced by prejudice, would approve. Some of the above purposes, it is hoped, will be fully accomplished, because we propose to set forth in detail the manner in which the experiments were conducted, to record all the facts observed just as they occurred, to tabulate the work in the most scientific manner possible, and thus present to competent experts a basis for conclusions. When all this is done



it is evident that different conclusions may be derived from the premises by different persons. Whatever our conclusions may be, therefore, we do not claim for them any special virtue, but we do hope so to establish the facts on which they are based that the necessity for a repetition of the work may be relegated to the remote future. The enormous amount of work connected with such experiments and the great expense which necessarily attends them render it extremely advisable that the work should be thoroughly done, with every possible regard for accuracy, with elimination as far as possible of all sources of disturbance and error and with the establishment on as firm a basis as possible of the recorded observations.

An outline of the method of making the experiments will be useful in explaining the detail of the work.

In the first place, it is evident that no mere theorizing on the chemical and physical properties of preservatives and coloring matters can be of much value in work of this kind. It is further evident that pharmacological experiments made upon other animals than men, valuable as they are, will not lead to absolutely definite results. It is well known that the digestive organs of other animals are different from those of man, that the processes of assimilation vary, and that what might be innocuous to such an animal might in other circumstances prove harmful to man, and vice versa. It was therefore concluded that the experiments, to be of full value, should be made upon the human animal. Fortunately, the Department of Agriculture is richly provided with subjects for experiments if only their consent thereto can be obtained.

First of all, therefore, a statement was made of the object of the experiments, and this was submitted to a number of young men connected with the Department, who were, for the most part, college graduates or students engaged in scientific pursuits, but employed at a low rate of compensation. The only inducement offered to these young men to engage their attention and consent, in addition to the contributions to the progress of science which they would make, was that of free board during the period of the experiment. This, indeed, must be considered as a very small reward for the restrictions under which they were compelled to live for so long a period. Nevertheless, large numbers of volunteers presented themselves, far in excess of the actual demand. Each applicant was requested to fill out the blank which follows:

*Descriptive blank to be filled out by applicant for hygienic table.*

1. Name and address: \_\_\_\_\_.
2. Date of birth: \_\_\_\_\_.
3. Have you had any sickness confining you to your room within a year? \_\_\_\_\_. If so, state nature and duration: \_\_\_\_\_.
4. Are you subject to indigestion? \_\_\_\_\_. If so, state character and frequency: \_\_\_\_\_.
5. Do you use coffee, tea, or chocolate with your meals? \_\_\_\_\_. If so, state at which meals and what beverage you prefer: \_\_\_\_\_.
6. Do you use tobacco? \_\_\_\_\_. If so, state in what form, at what times, and quantity: \_\_\_\_\_.
7. Do you use wine, beer, or other alcoholic beverages? \_\_\_\_\_.
8. Do you go to stool regularly? \_\_\_\_\_. At what hours? \_\_\_\_\_.
9. At what hours do you usually urinate? \_\_\_\_\_.
10. At what hour do you go to bed? \_\_\_\_\_. How many hours do you usually sleep? \_\_\_\_\_.
11. Do you engage in any unusual or violent exercise? \_\_\_\_\_. If so, what? \_\_\_\_\_.

The object of the above blank was to get an idea of the personal habits of the applicant, and especially to ascertain if he had been lately subject to any serious disease, or if he had any hereditary tendency to disease. It was also desirable to know whether the applicant was addicted to the use of tobacco or of alcoholic drinks, and if so, to what extent. I had hoped to be able to secure a sufficient number of applicants who used neither tobacco nor alcohol to make up the corps of cadets, but in this I was unsuccessful. Only a very small percentage of the applicants used neither tobacco nor alcohol. Since many scientific men recognize in alcohol a positive food value, and it was desirable to eliminate this beverage from the hygienic table, I finally decided to reject the application of all those who used, even to a moderate degree, alcoholic beverages. I then decided to accept, in so far as it was necessary to make out the number, the applications of those who used tobacco moderately.

It was decided at the beginning that the number at the experimental table should be 12, divided into two classes of 6 each. It was evidently impracticable for a young man to continue for seven or eight months in so strenuous a life at so small a compensation. The object of having two classes was that one should be resting while the other was undergoing experimental treatment, thus dividing the time as nearly as possible equally between the two. The number under experiment was subsequently increased to 14 for some special purposes. The members of the table having been selected, each one was required to subscribe to the following pledge:

I hereby agree, on my honor, to follow implicitly the rules and regulations governing the hygienic table of the Bureau of Chemistry during the time that I am a member thereof. I agree, during my attendance at the table of observation, to use no other food or drink than that which is provided for me, with the exception of water, and that any water not used at the table will be measured and reported daily as a part of the ration. I further agree that I will continue to be a member of the hygienic table for a period of at least six months, from December 1, 1902, unless prevented by some illness, accident, or unavoidable absence. I agree to continue the regular habits of my life, to indulge in no unusual excess of labor or exercise, and if tobacco be used it shall be used at such times and in such amounts as will be agreed upon between myself and the chief of the Bureau of Chemistry.

I further agree that I will not hold the Department of Agriculture, nor any person connected therewith, responsible for any illness or accident that may occur during my connection with the hygienic table.

It is evident that in experiments on the human animal it is necessary to rely to a certain extent upon the honor of the person under observation. I have every reason to believe that the members of the hygienic table kept their pledges faithfully. They were young men of high standing, fine character, with no bad habits, and they all took a lively personal interest in the work to which they were devoting themselves. They were required, as is seen by the pledge, to pursue their daily vocations in the usual way. In the case of those who used tobacco a statement of the quantities used, the character of the tobacco employed, and the times at which it was taken, was made, and they agreed to continue the use in exactly the same way during the entire period.

At the completion of an experimental period, in retiring from the experimental table and passing to the recreation table, the candidate was required to subscribe to the following certificate:

I hereby certify on my honor that during the period beginning ——— and ending ——— I have not partaken of any food or drink (except water reported) other than

that furnished at the hygienic table of the Bureau of Chemistry, and that I have accurately recorded all the items of food and drink received at the table.

I further certify that I have not engaged in any excessive or unusual physical exercise; that I have followed, in so far as possible, the regular tenor of my daily life in respect of work, exercise, and sleep; that I have observed to the best of my ability and recorded accurately the data relating to weight, temperature, and pulse; and that I have observed faithfully all the regulations connected with the experimental work at the hygienic table.

By thus placing the young men on their honor, by interesting them in their work, and by giving them periods of rest, during which they were at liberty to eat moderately at other tables than those set in the Bureau of Chemistry, I secured practically the results which would have been obtained by an absolute control of animals experimented upon both during the periods of eating and the intervening periods.

It may be asked: Why were so many persons selected? To this I reply that the idiosyncrasy of the human animal is very marked. Experiments made upon a single, or even two individuals, are apt to be very misleading by reason of this idiosyncrasy. I would gladly have extended the experiment to include 20, 30, or even 50 persons if it had been possible to do the analytical work necessitated by such a large number. One of the chief differences between the series of experiments under consideration and those previously made has been in this particular. A much greater number of subjects and longer period of time were involved than in any of the similar experiments that have heretofore been conducted. We have thus to this extent eliminated more completely the errors due to imperfect observation, imperfect control, and idiosyncrasy.

The installation of the kitchen was in one of the rooms of the basement of the Bureau of Chemistry which up to this time had been used as a storeroom. The cooking was done on two gas stoves and under the supervision of a cook certified by the Civil Service Commission.

The dining room was one of the rooms set apart for the road-material laboratory, which, however, could be used for the dining room without interfering materially with the work carried on in that room, as this was done chiefly at desks around the sides.

The food of each member of the table under observation was weighed or measured, the liquids, such as coffee, milk, tea, and water, being measured and calculated to weight from the density of the solution, the solid foods being weighed upon a torsion balance sensitive to half a gram.

A sample of the food furnished at each meal was taken for analysis, immediately placed in a bottle, stoppered and sealed with paraffin, so that no moisture could escape in the necessary interval of time before weighing and subsampling of the sample could be accomplished. Foods which could be used in bulk, such as prepared cereals, etc., were sampled only for each lot, thus reducing to some extent the labor of analytical work which was conducted in the food laboratory.

Not only did the analytical work include samples of all the foods used for each meal, but also samples of the urine and feces, which were carefully collected and weighed for each of the members of the table and subjected to analysis. In short, an account was opened with each member of the table exactly similar in character to a bank account. Each member was charged with all that was given him in food and credited with all that was returned in the excretions. The balance represented the food consumed in the production of heat and



energy within the system, provided the bodily weight remained constant. Thus an exact and accurate control was kept of each individual which would have made it impossible for him to have violated the rules by taking nourishment in addition to that given him, because all such additional nourishment would have at once been detected by a disturbance of the balance sheet. Each member of the observation table was weighed carefully on a delicate balance each day before dinner, since the determination of the weight of the body and its variations under the experiment are two of the most important of the data to be obtained. Each member of the table was furnished with blanks with which to keep an account of the foods received, the meals at which they were eaten, to enter a record of his weight, of the temperature before and after eating, of the pulse, and all other data connected with the income and outgo of the food. One of these blanks was filled up for each meal and the daily blank filed. From these blanks a statement of the foods consumed was made for each period of observation.

In the beginning of each experimental period there was first determined how much of the food would be necessary to secure as nearly as possible an even weight of the body. This part of the experiment was called the "fore period," and lasted for about ten days. At the end of this time the daily ration for each member of the table had been determined, and this was established as the standard of the ration which he should have during the remaining portion of the experimental period.

The "middle period" represented that portion of the time during which each member of the table ate the rations previously determined, together with the added preservatives, borax or boric acid. This period extended generally from ten to fifteen days.

This was followed by the "after period," during which the same ration as first determined continued, but the preservative was withdrawn, the object being to restore the body to its normal condition in case it had been disturbed by the use of the preservatives. The after period, as a rule, was ten days in length. Thus, the whole period under observation varied in each class from thirty to forty days.

The period of observation extended from December 1 to June 30, inclusive, and the only preservatives used were borax and boric acid. It is believed that the data obtained, although not yet fully tabulated, will go far to settle many disputed points and to establish on a firm scientific basis the principles which should guide the makers of legislation relating to the use of borax and boric acid. At the same time the other important purpose which was kept in view, viz, the guidance of the officials connected with the enforcement of the pure-food law, will have been attained as regards these two substances at least.

On account of the importance of the hygienic work in connection with the experiments in determining the effect of preservatives, coloring matters, and other added substances, upon health and digestion, it will be of interest to give the tables showing the amount of the principal items of food consumed during the period of experiments lasting from December 1, 1902, to June 30, 1903. The average number of persons fed, including the members of the table, cook, waiter, and other attendants, was 17. The amount of each particular food used, showing the amount purchased, the waste in cooking and other waste, and the net amount consumed as food, is found in the tables on the next page.

*Details of food used in experiments.*

## ROAST BEEF.

Date.	Meal.	Amount purchased.	Weight before cooking.	Weight after cooking.	Loss in cooking.	Other loss and waste.	Net weight.
		Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.
1903.							
March 30	Dinner	9	7	5½	1½	1½	4½
April 6	do	9½	9½	7½	1½	1½	5½
April 8	do	8	6¾	5½	1½	1½	4½
April 13	do	9	8½	7	1½	2	5
April 15	do	9	8½	5½	2½	1½	4½
April 20	do	9	8	6½	1½	1½	5½
May 4	do	7½	6½	4½	1½	2½	2½
May 6	do	7	6	5	1	2	3
May 11	do	8	7½	5½	1½	1½	4
May 13	do	7½	6¾	4½	2	2	2½
May 15	do	7½	7	5½	1½	2½	3
May 18	do	7	6	5½	3½	2	2
May 20	do	7½	7	6½	3½	2½	2½
May 22	do	7½	6½	5½	3½	2½	2½
May 25	do	8	6½	5½	3	2½	2½
May 29	do	6¾	5½	4½	1	2½	2½
June 1	do	8	7	5	1½	2½	3½
June 3	do	7	6	5	1	3½	1½
June 5	do	7½	6	4½	1½	2½	2½
June 8	do	7	6	5½	3	2½	2½
June 10	do	7	5½	4½	1	2½	2
June 12	do	7½	6	4½	1½	3	1½
June 15	do	7½	6½	5½	1½	3	2½
June 17	do	7½	6½	5½	1½	2½	2½
June 19	do	7	6	5	1	2½	2½
June 22	do	7	6	4½	1½	2	2½
June 26	do	7	5½	4½	1	2	2½
June 29	do	7½	6½	5½	1	2½	2½
Total		215½	186½	152½	34½	67½	84½
Average		7.7	6.66	5.43	1.23	2.41	3.02

Loss in cooking, 18.43 per cent.

## ROAST LAMB.

		Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.
1903.							
May 2	Dinner	6½	5¾	4½	1½	2	2½
May 5	do	6½	5¾	4	1½	2	2
May 9	do	6½	6½	4½	2	1½	2½
May 12	do	6½	6½	5½	1	2	3½
May 16	do	6½	6½	3½	2½	2	1½
May 19	do	6½	5½	4½	1	2	2½
May 23	do	6½	6½	4½	1½	1½	3
May 26	do	7	6½	4	2½	1½	2½
May 30	do	6½	5¾	4½	1½	2	2½
June 2	do	5½	5½	3½	2½	1½	2
June 6	do	6½	6	3½	2½	1½	2½
June 9	do	6	5½	3½	1½	2	1½
June 13	do	6½	5½	3½	1½	2	1½
June 16	do	6	5½	4½	1	1½	2½
June 20	do	7	6½	4½	2	1½	2½
June 23	do	7	6½	5½	1½	1½	3½
June 27	do	6½	6	3½	2½	1½	1½
Total		110½	100½	71½	29½	29½	41½
Average		6.5	5.9	4.18	1.72	1.73	2.45

*Details of food used in experiments—Continued.*

## BEEFSTEAK.

Date.	Meal.	Amount purchased.	Bone and other loss.	Weight before cooking.	Weight after cooking.	Loss in cooking.	Net weight.
1903.		<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>
April 2.....	Breakfast...	3½	¾	2½	1½	1½	1½
April 3.....	do.....	4	1½	3½	2	1½	2
April 6.....	do.....	3½	¾	2½	1½	1	1½
April 10.....	do.....	3½	1	2½	1½	1½	1½
April 16.....	do.....	3½	¾	2½	1½	1	1½
April 17.....	do.....	4	1½	3½	2½	1	2½
May 2.....	do.....	5½	2½	2½	1½	1½	1½
May 9.....	do.....	4½	2½	2½	1½	1½	1½
May 12.....	do.....	4½	2	2½	1½	1	1½
May 14.....	do.....	5½	1½	4½	2½	2½	2½
May 16.....	do.....	4½	2½	2½	1½	1	1½
May 18.....	do.....	5½	2	3½	2½	1½	2½
May 20.....	do.....	5½	2½	2½	1½	1½	1½
May 23.....	do.....	5	2	3	1½	1½	1½
May 25.....	do.....	5	2½	2½	1½	1	1½
May 30.....	do.....	5½	1½	4½	2½	2	2½
June 1.....	do.....	2½	1½	3	1½	1½	1½
June 3.....	do.....	6	3½	2½	1½	1	1½
June 4.....	do.....	5	2½	2½	1½	1	1½
June 8.....	do.....	4½	2	2½	1½	1½	1½
June 10.....	do.....	4½	2	2½	1½	1½	1½
June 15.....	do.....	4	2½	1½	1	1	1
June 17.....	do.....	4	2½	1½	1½	1	1½
June 18.....	do.....	3½	2	1½	1	1	1
June 20.....	do.....	3½	1½	1½	1½	1	1½
June 24.....	do.....	3½	1½	1½	1½	1	1½
June 27.....	do.....	4	2	2	1½	1½	1½
Total.....		120½	47½	73½	44	29½	44
Average.....		4.47	1.75	2.72	1.63	1.09	1.63

## CHICKEN.

Date.	Meal.	Weight before cooking.	Weight after cooking.	Loss in cooking.	Bone and other loss.	Net Weight.
1903.		<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>
April 5.....	Dinner.....	3½	2½	1	1	1½
April 9.....	do.....	3½	2½	1	1½	1½
May 7.....	do.....	6	4½	1½	2½	2½
May 10.....	do.....	5½	4	1½	2½	2½
May 14.....	do.....	6	5	1	2½	2½
May 21.....	do.....	7	4½	2½	2½	2½
May 24.....	do.....	6½	5	1½	2½	2½
May 31.....	do.....	5	3½	1½	2	1½
June 4.....	do.....	5½	3	2½	1½	1½
June 7.....	do.....	5	3	2	1½	1½
June 11.....	do.....	4½	3½	1½	2	1½
June 14.....	do.....	5	3½	1½	2½	1½
June 18.....	do.....	4½	3½	1½	1½	1½
June 21.....	do.....	4½	3½	1	2	1½
June 25.....	do.....	5½	4½	1½	2	2
Total.....		77½	55½	22½	29½	26½
Average.....		5.2	3.7	1.5	1.98	1.8

## COLLABORATION WITH EXECUTIVE DEPARTMENTS.

An important part of the work during the past year, which has not been committed to any single laboratory, was the collaboration authorized by Congress between the Bureau of Chemistry and other Departments of the Government whose respective heads apply to the Secretary of Agriculture for chemical work. This collaboration during the year has extended to almost every branch of the service. The most extensive work has been conducted in connection with the Treasury Department.



## WORK FOR THE TREASURY DEPARTMENT.

**SUGAR TESTS.**—The chief of the Bureau of Chemistry continues to exercise the functions devolved upon him by the joint action of the Secretary of the Treasury and the Secretary of Agriculture in making him supervisor of sugar tests at the appraisers' laboratories in Philadelphia, New York, and Boston. Exchange samples from these laboratories are received each day at the Bureau of Chemistry and subjected to a very careful analysis, far more care being exercised, naturally, than can possibly be used in the routine work in the appraisers' laboratories. These exchange samples are sent to each of the ports, and thus a daily check is secured upon the polarizations at the several ports of entry. At the end of each month these data are tabulated, in order that a monthly comparison may be made between the results obtained at the several ports and in the Bureau of Chemistry. Whenever any variation of a marked character arises in the polarizations an immediate investigation is made, and, if possible, the cause of variation ascertained and removed. This collaborative work, which has now extended over three years, has been productive of the most useful results. The wide differences in polarizations which formerly existed at the several ports have been practically eliminated and a surprising approximation in monthly averages has been secured.

**ALCOHOL.**—A most interesting investigation in connection with the Treasury Department was undertaken to determine the percentage of ethyl alcohol in certain fusel oils imported into this country. Ethyl (ordinary) alcohol pays a much higher rate of duty than the other alcohols of commerce, and is the only one of them which is at all suitable for use as a beverage. The other alcohols are extremely poisonous, and some of them, such as methyl alcohol which exerts a specific paralytic action on the optic nerve, are extremely dangerous even when taken in small quantities. As it is possible to separate, with more or less success, ethyl from the other alcohols, it might be that importation under the guise of fusel oil would seriously affect the revenue of the Government.

**EXAMINATION OF PRESERVED FRUITS.**—Another important investigation in connection with the Treasury Department was undertaken during the year, viz, the examination of pineapples from different parts of the world, in order to determine their natural content of sugar.

**EXAMINATIONS OF WATER AND ICE.**—Samples of water and ice were examined for the Bureau of Engraving and Printing, for the purpose of determining whether they were suitable for potable purposes. The examination showed that ice is apt to be contaminated by organic matter in a putrid or semiputrid condition, and such ice is totally unsuitable for human consumption in any form. The analysis of the sample of water disclosed the fact that the alum which had been used to precipitate the silt had not been allowed to act long enough to secure complete precipitation before filtering. The continued action of the alum after filtering produced turbidity and discoloration, causing the suspicion of the purity of the sample. The use of alum in water should never be practiced except under expert supervision, otherwise the health of the consumer may be seriously menaced.

## WORK FOR THE INTERIOR DEPARTMENT.

COAL.—At the request of the Secretary of the Interior, a series of examinations was conducted during the year to determine the character of coal consumed at the National Hospital for the Insane. The object of these investigations was to determine the calorific power of the samples furnished, and also the amount of sulphur or other injurious substances which the samples contained. The investigations, therefore, were not in the nature of complete analyses, but were confined only to those processes which would fully establish the calorific power of the material furnished.

PAPER.—Four samples of paper, used in the Geological Survey for its official business, were also received from the Interior Department. Three of these were ordinary printing papers, and were subjected to microscopic and chemical tests to ascertain their quality and strength. The fourth paper was one which was coated with casein and used especially for map printing.

## WORK FOR THE DEPARTMENT OF JUSTICE.

Two investigations were made for the Department of Justice during the year, both of them relating to beverages claimed to be exempt from the restrictions of the law, offered for sale in the Indian Territory. The problems which the Attorney-General asked to be investigated were the following: (1) The determination of the alcohol; (2) whether the beverages submitted were malt liquors; and, (3) whether they were fermented liquors.

Many problems similar to these have been submitted by the Attorney-General. The difficulties of a chemical nature which they present are at once apparent. Skillful mixtures of alcohol, malt, sugar, and coloring matter, together with extract of hops, might well be made, resembling in every particular the chemical composition of the samples submitted and yet not being strictly either a malt liquor or a fermented liquor. In so far as their effect, however, upon the human system is concerned, it is doubtless true that they would be more injurious than genuine malt liquor or fermented liquor of the same alcoholic strength. The only absolutely certain method of determining these latter points would be an investigation of the processes of manufacture. Dealers offering beverages of this kind for sale might well be required to furnish a statement, under oath, showing the method of manufacture and all other data necessary to judge whether or not the offered beverage is a malt or fermented liquor.

## WORK FOR THE GOVERNMENT PRINTING OFFICE.

Forty-three samples of glue for use in the Government Printing Office were submitted during the year for examination.

## WORK FOR THE POST-OFFICE DEPARTMENT.

Three samples of powdered aluminum, used for painting letter boxes; two samples of sizing used for the same purpose in connection with the aluminum, one sample of painter's japan, one package of postage stamps, two samples of postal-card paper, a large number of inked pads, and thirty-three samples of inks were examined during the year for the Post-Office Department.

POSTAGE STAMPS.—The principal object of the examination of the postage stamps was to determine whether the different inks used in canceling them could be removed without defacing the stamp to such an extent as to prevent reuse in the mails.

#### FACILITIES FOR COLLABORATIVE WORK.

In the interests of economy and efficiency in the public service it seems important that more elaborate provisions be made for the work which may be asked for by other Departments of the Government in the solution of chemical problems of various kinds. It is evident that the establishment of separate laboratories for such purposes would be extremely costly, as well as requiring the employment of experts, who would be necessarily selected for a specific purpose and for a limited time. The character of such miscellaneous work would be affected by lack of supervision and uniformity, and the results obtained would not carry the weight and authority which would attach to them if done under the supervision of this Department, or some other Department authorized by Congress to conduct such work in a systematic manner. The equipment of the Bureau of Chemistry has appeared to offer better facilities for this collaborative work than that of any other Government laboratory in Washington, and for this reason little by little the amount of this work has grown until now it is of a magnitude to employ constantly one or more of the chemists connected with the Bureau and to utilize a portion of the laboratory supplies and fixtures. It would be impracticable to exactly estimate the amount expended during the fiscal year for this service, but it is probably not less than \$5,000. The growing needs of the service, the increasing amount of the work, and its growing importance warrant a more elaborate provision for conducting it, which will be referred to again in the part of this report devoted to the estimates for the fiscal year beginning July 1, 1904.

#### WORK OF THE LABORATORIES.

The particular work of the different laboratories connected with the Bureau will be found in the following summary:

##### THE FOOD LABORATORY.

The work of the laboratory in the examination of olive oils, which was in progress at the beginning of this fiscal year, has been completed. In addition to the olive oils previously examined 48 new samples have been secured, and the results of the complete investigation have been compiled and will shortly be issued as a bulletin.

The examination of tropical fruits has also been continued, and 24 samples of prepared fruit products from Cuba have been examined. In addition to the usual examinations complete analyses have been made of the ash of all the samples of tropical fruits and fruit products examined. The work on this subject has been completed, and the results will be included in a bulletin to be issued during the coming year.

The study of the composition of fruit, with special reference to the changes in composition during ripening in different methods of storage, has been continued in collaboration with the Pomologist. Three varieties of apples were sampled at different periods during their growth and maturity, allowed to ripen under different conditions, and their



composition determined. The manner of ripening of apples picked and stored at different stages of maturity has also been studied, and two varieties picked both in the mature and immature states will be held in cold storage to study the effect of long keeping on their composition. Many perplexing problems have presented themselves in connection with this study. In order to make the work of sufficient scope for satisfactory results it was considered necessary to determine solids, ash, starch, sucrose, reducing sugar, pectin bodies, tannin, cellulose, and nitrogen. It may also be of importance to note at different stages of the maturity of the fruit the relative amount of certain of these substances which are present in the insoluble state.

There has not been time to make a systematic attempt to perfect methods for all the determinations mentioned, but considerable attention has been given to the determination of starch, pectin bodies, tannin, and cellulose. The methods employed with many agricultural products for the determination of starch are not applicable to fruit, because of the impossibility of separating starch, or the product of its hydrolyzation with diastase, from the apple cell. It was therefore found necessary to remove the sugars by washing and hydrolyze the soluble material directly with hydrochloric acid. As is to be expected, too high a result was obtained, owing to the hydrolyzation of other substances by means of the acid. By a change in the apparatus and the details of manipulation this error has been considerably decreased.

The problem of distinguishing the various kinds of cellulose in the growing apple was given considerable attention, and the methods now employed enable us to determine the percentage of ordinary cellulose and of ligno and cuto cellulose. The former are present in but very small amounts in the fibrovascular bundles, while the latter constitute the greater part of the peeling of the apple. It is believed that considerable progress has been made with the methods employed for this work, though owing to the complex nature of the product there is still much to be desired.

Aside from the experimental work in the examination of methods, 130 samples of apples have been analyzed in connection with this study. The work of the past year also includes studies of the respiration of apples and of the nature of what is commonly known as "scald."

An important part of the work of the food laboratory has also been done, as heretofore, at the request of other Departments. The study of the composition of pineapples has already been mentioned in the account of collaborative work with the Treasury Department. A summary of the results obtained from this investigation was printed in the Journal of the American Chemical Society for March, 1903. The work done in this laboratory at the request of other Departments also includes the examination of samples of fusel oil for the Secretary of the Treasury, the examination of nonalcoholic beers for the Attorney-General, and of samples received from the subsistence departments of the Army and the Navy.

One hundred and thirty-four samples of fruit sirups and nonalcoholic beverages have been secured in the open markets and examined. The examination of grape juices, which was made in this connection, is of considerable interest in the improvement indicated since our last work on the commercial method of preserving this product. It is but a few years since practically all of the unfermented grape juices on the

market were chemically preserved. In the samples examined during the last fiscal year, however, chemical preservatives were the exception, the great majority having been preserved by sterilization alone. In this class is also included a number of malt extracts, whose examination is somewhat difficult, owing to the necessity of distinguishing the preparations made from malt from those of cheaper and inferior grade.

The food laboratory has also done an important work during the last fiscal year, as heretofore, in investigating and comparing methods for the examination of a large variety of foods. This work was undertaken at the request of the Association of Official Agricultural Chemists, in which the chief of the food laboratory is at present referee on food adulteration. He has worked in collaboration with 19 prominent food chemists in the United States and Canada in the preparation and collection of these methods. Among the contributions of the food laboratory to this subject may be mentioned the determination and correction for temperature of refractive indices of oils, which was published in the *Journal of the American Chemical Society* for August, 1903; the comparison of different methods for iodine absorption, published in the *Journal of the American Chemical Society* for March, 1903, and the study of the methods for the determination of the ordinary food preservatives.

Two members of the food laboratory staff have done considerable work as associate referees on sugar for the Association of Official Agricultural Chemists. The effect on the rotatory value of invert sugar of hydrochloric acid employed in the determination of cane sugar has been studied, and a formula suggested to correct an error which has commonly been made in the determination of cane sugar in substances containing a large amount of invert sugar. Considerable attention has also been given in the same connection to the study of the methods employed for the determination of reducing sugars with the idea of establishing a method and constructing tables which will make it possible to determine all of the various reducing sugars by the use of a common solution and manipulation. This important study is far from complete, but considerable progress has been made.

During the last fiscal year Bulletin No. 69 (parts 1 to 5, inclusive), which consists of a compilation of the food laws in force in the United States, has been published in addition to the other publications noted above.

Since the 1st of December, 1902, the work of the food laboratory has been largely confined to the analytical work in connection with the study of the effect of preservatives on human nutrition. In this work about 5,500 samples have been examined and the results calculated and tabulated. The difficulties encountered were due to the large volume of work undertaken, making it necessary to devise special apparatus and facilities and to systematize the work to the utmost extent. The determination of boric acid in the urine probably afforded more difficulty than any other portion of this investigation. Owing to the great number of determinations to be made it was found impracticable to make use of the old method, depending on distillation with methyl alcohol, and the error occasioned by the slight solubility of barium phosphate constituted an objection to the volumetric method. This difficulty, however, was to a large extent overcome and satisfactory results obtained.

## THE INSECTICIDE AND AGRICULTURAL WATER LABORATORY.

During this year 45 samples of mineral waters were examined, the results on 35 of which are to be used in the preparation of a bulletin upon the composition of the commonly used mineral waters of the United States. Each of these examinations embraced the determination of 20 constituents.

Ninety-eight irrigation waters were either wholly or partially examined. This work was performed in collaboration with the office of irrigation investigations.

Forty-two sanitary examinations of waters were made. Thirty of these are to be incorporated in a bulletin, while the remaining 12 were, in the main, made upon the request of the health authorities of small towns where the water supply was suspected of causing disease, or upon the request of other departments of the National Government.

One hundred and fifteen insecticides were analyzed. One hundred and seven of these examinations were reported in Bulletin No. 76, of this Bureau. The remaining 8 were made by request of the Division of Entomology.

The arsenic content of 528 wall papers, 43 pairs of stockings, 95 ribbons and cloths, 12 fur rugs, and 34 fur pieces was determined, so that a bulletin might be prepared showing how much arsenic is contained in these classes of goods, and what the probable effect would be upon the health of the community.

Nine toxicological examinations were made, 5 for the Division of Entomology and 4 for individuals. The examinations made for the Division of Entomology were to determine whether bees had been killed by poisons used in spraying.

Forty-one cattle foods were examined, most of which examinations are to be reported in bulletin form.

The determination of alkaloids in 24 samples of drugs was made by this laboratory for the Bureau of Plant Industry before a drug laboratory was established.

Three hundred and fifty determinations of the fat content of foods and feces were made in duplicate for the food laboratory.

Twenty-one miscellaneous examinations were made for the U. S. Fish Commission and individuals.

INVESTIGATIONS AND THEIR RESULTS.—The examination of the prominent mineral waters sold upon the American market is not yet completed, but will be during the coming year. Enough work has been done, however, to show that in many cases the waters do not possess the advertised composition. This is especially true of the lithia waters, many of which contain only traces of this element.

The examination of 107 samples of pyrethrum powders shows that these are often adulterated with lead chromate to give them a yellow color. While such an adulteration may be demanded by the trade, it is very reprehensible in that the breathing of lead chromate day by day by human beings is apt to cause lead poisoning. The results of this investigation have been published as Part I of Bulletin No. 76, entitled "Insecticide studies." Part II of this bulletin is made up of a compilation of analyses of insecticides and fungicides made by the various experiment stations, while Part III includes the State laws governing the composition and sale of Paris green and other insecticides.

The examination of wall papers, furs, and fabrics for their arsenic



content has not yet been completed, but enough work has been done to show that this poisonous metal is very widely distributed in goods of this character, especially in fur rugs, black stockings, and red and black cloth.

A study of the free arsenious oxid in Paris green that can be endured by trees is under way, but the results are not yet ready for publication. This spraying work is in progress not only in this laboratory, but samples have also been sent to ten of the experiment stations, which will report on the results during the autumn.

The chief of this laboratory, as referee on insecticides and fungicides of the Association of Official Agricultural Chemists, has spent some time during the last year in comparing methods of analysis for these classes of compounds, and in outlining the work which is to be presented at the fall meeting of this association.

Besides the above investigations, one of the members of this laboratory has published two articles, one upon "Comparative methods of determining formaldehyde," and the other upon "The determination of formaldehyde in milk." Another member has published an article entitled "A modification of the Avery-Beans method for determining total arsenious oxid in Paris green." An investigation is now in progress upon a method for determining iodine and bromine when present in very small quantities in mineral waters. In addition to the publications above mentioned this laboratory has issued the following papers during the past year: "Analysis of waters and interpretation of the results," an article for the Yearbook; "Report of the referee on insecticides and fungicides for 1902," a report to the Association of Official Agricultural Chemists; "A review of the progress in the chemistry of insecticides and fungicides since July 1, 1900," and "A review of the progress in the analysis of cattle foods since July 1, 1900," for the Fifth International Congress of Applied Chemistry.

#### THE SUGAR LABORATORY.

The following-named samples have been analyzed in this laboratory:

Nine hundred and twelve samples of sugar for the Treasury Department, on which were determined the sucrose and water (on one-half).

Two hundred and ninety-nine samples of sugar beets, on which were determined the loss in topping, average weight, yield per acre, solids in juice, sucrose, fiber, and purity.

One hundred and ninety-eight samples of cane sirup, 71 samples of sorghum sirup, and 1 sample beet molasses, on which were determined the color, viscosity, total solids, ash, sucrose, reducing sugar, and purity.

Twelve samples of sugar cane, 2 samples of sorghum, 160 samples of sugar-cane juice, and 45 samples of sorghum juice, on which were determined the solids in the juice, sucrose, reducing sugar, and purity.

Twenty-three samples of muskmelons from the Potomac Flats and from several of the experiment stations, on which the following determinations were made: Proportions of rind, edible portion, and center; solids, ash, sucrose, and reducing sugar in juices of rind and edible portion.

Twenty-one samples of honey, on which were determined the sucrose and reducing sugar.

In all, 1,744 samples have been examined, with an average of 3.7 determinations on each.

A color standard for sirups was devised and 8 sets of standard colors made up for distribution.

A "flow" viscosimeter, designed by the chief of the Bureau, and made by the machinist of the road material laboratory, was carefully standardized with pure-sugar solution, and a viscosity table made from the determinations was used throughout the sirup work. In connection with this work, it was attempted to determine the moisture in the sirups by drying a part of the samples in a vacuum oven at 70° C., and the rest in a water oven at 100° C. With only a very few exceptions, the results showed from 1 to 10 per cent more water than was possible with the amount of solids present, due probably to the breaking down by heat of some of the sugars. The results obtained from the vacuum oven were as wide as those from the water oven. The amount of error appears to be nearly proportional to the amount of reducing sugars present.

#### THE DAIRY LABORATORY.

The number of samples examined more or less thoroughly and reported upon during the year was 1,056. Of this number, 807 were reported to the dairy division of the Bureau of Animal Industry, 233 were samples of milk and butter consumed at the experimental or hygienic table, and 16 were reported to individuals.

In addition to the samples reported, a considerable number have been analyzed in the study of methods proposed for distinguishing renovated from genuine butter, for detecting adulteration of butter, and for simplifying present methods of analysis. The results of these studies are upon record, and some of them, after further prosecution of the work, may prove worthy of publication.

The greatest difficulty encountered in the work of the year has been in the study of butter from the South, produced by the liberal feeding of cotton seed or cotton-seed meal. The difficulty lies in distinguishing with certainty between some such butters in their purity and similar ones moderately adulterated with foreign fats. It is intended to continue the study of this subject more thoroughly the coming year.

The chief of the dairy laboratory on two occasions during the year served as a witness for the Bureau of Animal Industry in a renovated butter case tried in the United States court for the western (Buffalo-Elmira) district of New York.

#### THE CONTRACTS LABORATORY.

The work of this laboratory, which was necessarily of a rather heterogeneous character, consisted mainly in the examination of samples submitted with bids for contract work for different branches of the Government, and in the development of qualitative and quantitative methods for the analysis of the same. The total number of samples as entered upon the index book was 135, and many other minor analyses were made in the course of the work for the purpose of determining special points at issue.

Of the 135 samples, 40 were miscellaneous, and included 8 dyes used by the native Indians for face powder and blanket dyeing; a sample of wocas hulls used by the Indians for a black dye; 6 samples of dyes furnished by the Indian Rights Association to the Navajo Indians for blanket dyeing, 4 of which required only a qualitative examination; 10

requiring both qualitative and quantitative determinations of impurities of reagents furnished the Bureau of Chemistry, including some very careful work in the estimation of caustic and carbonated alkali in sodium and potassium hydroxid, c. p., and comparative tests of the value of methyl orange and phenolphthalein as indicators, and 11 samples of rosin oils and rosin spirits from different manufacturers, from which, by careful fractional distillation, there was prepared a scale of fractions that it was hoped might be of service in the ink determinations.

Of the contract work, properly so-called, 60 samples were inks furnished by the Post-Office Department; 33 were samples of paints from the Bureau of Engraving and Printing, Treasury Department, and the other two were a stamp pad for use with rubber stamps, received from the Post-Office Department, and a specimen of khaki cloth from the Navy Department.

A complete inorganic chemical analysis of the sample of khaki cloth was made. The dressing, ash, hygroscopicity, and tensile strength were determined, and many other physical and chemical tests were made. The special purpose of the investigation of stamp pads was the determination of the value of a layer of blotting paper placed between the two layers of felt forming the pad. Microscopical and physical tests of the stamping value, working qualities, and penetrative ability of blotting paper were made, and quantitative determinations of the amount of lampblack filtered out by the paper and by the felt of the pad.

The work on paints included extensive comparative tests of the value of various quantitative methods for the determination of the essential ingredients of the paints, such as lead, chromium, iron, zinc, and manganese; qualitative examinations of all of the paints submitted; quantitative determinations of the impurities in many of them; the determination of the ash and moisture; and an extended and laborious research, having for its object the development of a method of separation by fractional elutriation of finely divided paints, such as barytes, the value of which depends upon its lack of coarser particles which abrade the plates used in printing and engraving. Much work was done also in the determination of the carbonaceous matter in black paints by means of the combustion furnace.

The work with inks included the development of a set of methods for testing canceling inks for rubber and metal stamps, as well as the ingredients used in the making of the same. This branch of the work also included the examination of a large number of samples submitted for test under the methods. Much comparative work was done to establish the best method for determining each essential characteristic of an ink for a special purpose, and, the method well determined, it was applied in the testing of many substances. For instance, having established a good method for determining volatility by means of a comparison of the best methods in use, the volatility of different kinds of rosin oils and rosin spirits, of many miscellaneous samples of inks, of pure glycerin, and of mixtures of glycerin with water, alcohol, acetic acid, etc., in different proportions, was determined.

Similarly, when studying the sedimentation test, many different kinds of lampblack were treated as described in the methods for determining the degree of fineness required for an ink of good sedimentation value, as given in Circular 12, Bureau of Chemistry. A



large number of specific-gravity determinations were made with the pyknometer; various dyes used in the manufacture of inks were tested for solubility, resistance to light and reagents, etc.: the saponification numbers of rosin oils, inks, ink residues, olive oil, linseed oil, and varnishes were ascertained, with a view to applying such figures in the work with inks; and a number of sample inks were prepared according to recipes developed in the laboratory, some of which were sent to the Post-Office Department to have their working qualities tested.

In the manner above outlined each test as described in the methods was first developed and then applied in the determination of a number of substances, so as to establish a set of standards whereby to judge of an unknown ink.

#### THE ROAD-MATERIAL LABORATORY.

The work of this laboratory has proceeded along the same general lines as in previous years, though with more expedition, due chiefly to a larger and more efficient working force.

The work of the chemist included a research to investigate the cause of the binding or cementing power of rock dust, gravels, and clays. It involved many complete analyses and the determination of the water of combination of over 100 samples. The results of the research were satisfactory and have been published as a contribution from the Bureau of Chemistry in the *Journal of the American Chemical Society*.

A series of experiments were also made on the burning and clinking of clays, with a view to their use as road materials.

A research is contemplated, and already something has been done, to determine whether the binding power of materials can be increased by artificial means.

In addition to research, considerable time has been given to experimental work in connection with various analytical methods with a view to modifying, improving, and shortening the ordinary methods of rock analysis to meet the especial needs of road-material work. The modified scheme is published in Bulletin No. 79 of the Bureau of Chemistry.

In the regular routine work complete chemical analyses have been made of 123 samples and 17 samples have been identified. Besides the chemical analyses for the identification and classification of rocks, 66 petrographical analyses have been made, which required the cutting and mounting of 80 thin rock sections. In this petrographical work a new method has been devised and put in operation in the laboratory by which the percentage of various minerals composing a rock can be determined with a very fair degree of accuracy. The routine physical and mechanical tests include 42 abrasion tests, 97 cementation tests, which required the testing of 485 briquettes, 3 complete rattler tests on paving brick, 150 tests on Portland cement, and 38 determinations of specific gravity.

In collaboration with the Bureau of Forestry 9 complete tests on full-size timber were made and numerous minor tests. A report was prepared for the Bureau of Forestry containing a complete scheme for the future timber investigations. The effect of volatile oils on the strength of timber was also suggested and partially investigated, and a method and the necessary apparatus were devised for determining the percentage of volatile oils in wood. A new apparatus was also designed for determining the moisture in wood more accurately than it has heretofore been done. An automatic and autographic universal testing machine of 200,000 pounds capacity was installed in the laboratory by

the Bureau of Forestry, and is intended primarily for the testing of timber.

An impact machine has been designed and constructed and is now in operation by which the toughness of rock can be determined. This is an entirely new field of investigation, having never been undertaken elsewhere. A machine for determining the hardness of rock has also been designed and constructed and is now in operation. This machine is modeled closely after the Dorry machine of the National School of Roads and Bridges of France.

Besides the general work of construction and repair for the laboratory, the machinist of the laboratory has done eighty-three days' work for other laboratories of the Bureau.

#### THE DRUG LABORATORY.

The drug laboratory went into operation on March 1, 1903, and the work is now fairly well organized. Already there have been analyzed in this laboratory 120 samples, consisting of material sent from the Bureau of Plant Industry, samples from the Post-Office Department, the Government Printing Office, and a goodly number of chemicals as delivered to the Bureau of Chemistry. No particular difficulties have been encountered in the work.

A number of representative samples of drugs for investigation have been secured, but only a part of the work has thus far been finished on these samples. The results on some of these investigations, especially in the work done on chemicals, shows that these articles are of very unsatisfactory quality.

The manuscript has been prepared for a bulletin to be entitled "Adulterated drugs and chemicals."

#### CLERICAL WORK.

With the expansion of the laboratory work of the Bureau the clerical work has greatly increased in magnitude and become much more diversified in character. During the year ending June 30, 1903, 7,342 letters have been written, covering 8,872 pages of typewriting. Numerous papers embodying results of investigations and records of research work have been prepared, representing, in round numbers, 4,000 pages of typewriting. A simple statement of the number of typewritten pages gives no accurate idea of the amount of work done, since much of it has involved the looking up of original matter, verifying references, and abstracting articles of a strictly scientific character.

The hygienic experiments of the Bureau have entailed a mass of tabulation, indexing, and calculation for which the present clerical force is entirely inadequate. It was found necessary to call upon the Division of Statistics for assistance in this work, and valuable help has been given by that Division continuously during the conduct of the experiments. A large amount of this work, however, has been done in the Bureau. Since December 8, 1902, 5,500 samples of the food used in connection with the hygienic table have been indexed, about 33,000 calculations made, 10,660 food and temperature charts made out, 1,600 pages of manuscript typewritten, and hundreds of tabulations made, in addition to a card index giving detailed information in regard to the work, abstracts of literature bearing on the subject, etc.

In addition to the work mentioned above, tabulations of the results of the analytical work of the Bureau have been made, chemicals purchased, and miscellaneous samples received for examination have been indexed, the accounts of the Bureau kept up to date, and a vast amount of miscellaneous work performed which it is impossible to classify and enumerate.

#### EDITORIAL WORK.

Thirty-eight publications, including bulletins, circulars, and reprints, have been issued during the fiscal year. Of this number, 14 were new bulletins and 2 circulars, the remainder being reprints. These publications contained a total of 3,000 pages, of which 1,312 pages were new matter. In addition to this a special report on wine making in France has been submitted for publication as a Congressional report.

The job printing for the Bureau has included, besides the usual supplies, circular letters, postal cards, etc., the issuing of outlines of work for the food standards committee and the referees of the Association of Official Agricultural Chemists, and a number of forms for the conduct of the experimental work in food adulteration.

The mailing list of the Bureau has been carefully revised by correspondence and reduced about 50 per cent. The names remaining on the list have been classified so as to make possible the most efficient and economic distribution of the bulletins, a step made necessary by the specialization of the work of the Bureau and the consequent effect upon the reports issued, such widely differentiated topics being treated that but few persons would be interested in all of the publications.

#### FINANCIAL STATEMENT.

The expenses of the Bureau during the fiscal year are itemized as follows:

Statutory roll .....	\$13,200.00
Miscellaneous fund .....	52,333.27
Sirup .....	8,166.73
	<hr/>
	73,700.00

#### MISCELLANEOUS FUND.

Pay roll .....	30,792.20
Rent .....	2,800.00
Gas .....	508.20
Electricity .....	187.08
Chemicals .....	2,972.22
Apparatus and equipment .....	9,422.70
Lumber .....	241.68
Office supplies and furniture .....	433.50
Plumbing and hardware .....	817.92
Kitchen and dining-room furnishings .....	317.78
Food and provisions .....	1,694.86
Letters for travel and samples .....	1,408.00
Miscellaneous .....	487.13
Balance unexpended .....	250.00
	<hr/>
	52,333.27

#### SIRUP FUND.

Pay roll .....	5,283.43
Travel and supplies .....	2,883.30
	<hr/>
	8,166.73



# OUTLINE OF WORK PROPOSED FOR THE FISCAL YEAR ENDING JUNE 30, 1904.

## LABORATORY WORK.

### FOOD LABORATORY.

The work of the food laboratory during the coming fiscal year will be almost entirely devoted to the analytical work connected with the study of the influence of preservatives on human nutrition, and to the work incidental to the enforcement of the food law. In the plan submitted herein it is taken for granted that the work necessitated by the food law will not require the time of more than one analyst. In case a larger volume of work than is expected should be involved, a correspondingly greater amount of assistance will be necessary. It is expected that this investigation will be taken up again about the 1st of October, and the determinations which were made during the last fiscal year will be continued, and in addition thereto the sulphur in both food and excrement will be determined.

It is proposed to continue the study of the ripening of fruit in collaboration with the Pomologist, and to take up, in addition, during the summer months the study of the banana in connection with the section of tropical agriculture of the Bureau of Plant Industry.

The work of the laboratory in connection with the Association of Official Agricultural Chemists on the study of food methods will be continued. In this connection a study will be made of the amount of aldehydes and salicylic acid which may occur naturally in foods of various classes with the idea of determining the probability of errors from such bodies in the examination of foods.

The estimate for 1904-5 is based on the supposition that the work required by the food law will reach considerable proportions during that fiscal year and that we shall then not be able to secure the assistance now received from the Statistician. In case the analytical work expected of the food laboratory is not greater than at present, and assistance can still be obtained from the Statistician, it will be possible to reduce the estimates for salaries to about \$13,000. These estimates do not take into consideration the salary of the chief of the laboratory, as his name is now on the statutory roll.

#### *Estimate of expenses for food laboratory.*

2 assistants, at \$1,800 .....	\$3,600
3 assistants, at \$1,000 .....	3,000
2 assistants, at \$840 .....	1,680
2 assistants, at \$720 .....	1,440
1 clerk, at \$1,000 .....	1,000
3 calculators, at \$840 .....	2,520
2 laborers, at \$480 .....	960
Total salary of assistants .....	16,105
Traveling expenses, purchase of samples, and special apparatus .....	1,400
Total .....	17,505

#### THE INSECTICIDE AND AGRICULTURAL WATER LABORATORY.

During the coming year the study of the arsenic content of wall paper, fabrics, etc., will be continued and will doubtless be finished by autumn.

The work upon the mineral waters sold on the American market will also be continued. Since these waters are so often used as medicinal remedies, yet do not contain the ingredients claimed by the owners of the springs, it appears that they are well worthy of further study, and it is purposed to buy a number of these waters, not to be obtained in Washington. An authorization of \$65 for traveling expenses and purchasing samples is recommended.

It is also intended to undertake a study of cattle foods sold upon the American market. For this study an authorization of \$100 for the purchase of samples is necessary.

The studies on the effect of the free arsenious oxid in Paris green on foliage will be continued and extended to the study of agricultural products that have been sprayed with poisonous metals in order to determine whether they contain such poisonous metals when they reach the consumer.

The collaboration with the Division of Entomology in a study of insecticides and with the office of irrigation investigations in a study of irrigation waters will also be maintained.

The following estimate of the expenses for conducting this laboratory for the fiscal year ending June 30, 1905, does not include the cost of glassware, chemicals, etc.:

*Estimate of expenses for insecticide and agricultural water laboratory.*

Salary of chief .....	\$2,500
Salary of 2 assistants, at \$1,200 .....	2,400
Salary of 1 student assistant .....	480
Purchase of samples .....	300
Total .....	5,430

THE SUGAR LABORATORY.

For the ensuing year the work on the Treasury sugars will go on as usual. The work on sugar cane and cane sirups will be even more extensive than during the past year, as also will the work in the field on the cultivation of sugar cane and the manufacture of sirups for the table on a commercial scale.

The object in view is to establish the principles of a chemico-technical nature governing the manufacture of table sirups, in order to secure uniform quality, standard color, freedom from fermentation, and security against crystallization. If these points can be established, there will doubtless be a marked increase in the demand for palatable and wholesome sirups of this character.

It is also desired to undertake more extensive investigations in the growth and utilization of cassava, especially for starch and glucose manufacture. The problems relating to the uses of cassava for cattle food have been well solved, but others of a more technical nature invite further investigation.

The utilization of the sweet potato and the yam, which grow so abundantly in the sandy soils of the Southeastern States, will also receive attention. This study involves very important problems of a chemico-technical nature, which, if correctly solved, will add much to the agricultural wealth and industries of the regions named.

An addition of \$5,000 to the fund appropriated for the current fiscal year would enable this laboratory to undertake the additional problems, and, therefore, the estimate for the sugar laboratory for the ensuing year is placed at \$20,000.

## THE DAIRY LABORATORY.

The principal lines of work which it is intended to pursue during the year are as follows:

(1) Continuation of the study of methods for distinguishing renovated from genuine butter.

(2) Continuation of the study of Poda's method of butter analysis, with modifications.

(3) Complete analysis of samples of all brands of canned milk or cream, condensed milk, and milk powders sold in the markets of the United States.

(4) A thorough study of the fat of cotton-seed butters, especially those produced by excessive feeding of cotton-seed products.

(5) Any work in dairy chemistry that may be desired by this and other Bureaus of the Department.

The expense of conducting the laboratory on a satisfactory basis is estimated as follows:

*Estimate of expenses for dairy laboratory.*

Salary of chief .....	\$2,000
Salary of assistant .....	720
Salary of helper .....	600
Supplies .....	180
Total .....	3,500

## THE CONTRACTS LABORATORY.

The work of the contracts laboratory for the coming year must necessarily depend to a large extent upon the number and nature of samples submitted by this and other Departments with bids for contracts. During the past year this class of work was confined largely to paints and inks. At present a large number of inks are on hand upon which a preliminary report has been made. The examination of these inks is to be continued for the purpose of establishing the nature of the base and the dyes used, and the resistance of these dyes to the action of sunlight and other agents. It is believed that the power of an ink to carry carbon into the paper depends largely upon the solvent used. A few of the inks examined possess this quality to a marked degree, while others are entirely devoid of this power. Since the indelibility of canceling ink depends upon the penetration of the carbon into the paper this property is of great value. In connection with the investigation of inks there is need that the effect of different ink bases upon the rubber stamp used for canceling purposes be studied.

In accordance with General Order No. 68, issued April 15, 1903, in which "chiefs of Bureaus, Divisions, and Offices of the Department are requested to collaborate with the chief of the Bureau of Chemistry in securing data and materials for an investigation to be undertaken for the purpose of ascertaining the factors which determine the durability and other qualities of typewriter ribbons," a number of samples of ribbons have been sent in and a study of these will be made.

Owing to the extensive use of oils for lubricating purposes and in the manufacture of materials on Government contract, such as paints, inks, etc., and to the fact that these oils are quite commonly adulterated, it is suggested that an investigation of these be taken up during the coming year and continued as time allows. Work of this



kind must necessarily be done in connection with the study of the bases used in the manufacture of ink, and can then be extended to include other materials. This work can be made a very important part of the investigations of the contracts laboratory. A report was made upon the amount of ethyl alcohol in fusel oils, this work having been taken up at the request of the Treasury Department.

It seems highly desirable that the work of this laboratory be continued along the lines mapped out by Mr. E. E. Ewell, viz, to establish methods that will be of practical value in determining the quality of various materials submitted with bids for contracts, and of the ingredients entering into their composition, and then so far as seems practicable, to establish specifications for these materials. This has already been done in the case of inks and is possible with many other classes of materials.

If the work of this laboratory is developed this year, as it now seems probable that it will be, the amount of work required and its usefulness will be greatly increased. It is probable, too, that considerable special apparatus will be required for the laboratory. It is therefore suggested that the estimates be sufficiently large to provide at least one additional assistant and such special apparatus as may be necessary. A total of \$10,000 will be sufficient to cover the probable expenses of this laboratory for the year 1904-5.

#### THE ROAD MATERIAL LABORATORY.

During the coming year two new tests will be adopted by this laboratory for determining the hardness and toughness of rock. These tests will be regularly carried out on all routine samples and reported on, and it is believed that they will be of much assistance to road builders. Aside from these two tests, the general testing of rock for macadam roads will be carried on in the same manner as before. Much work has already been done by this laboratory for determining the quality of clay best adapted for burning, and it is hoped that it will be possible during the coming year to make a thorough practical test of burnt clay for country highways. If such an experiment proves successful, one of the greatest road-material problems will be solved, for there are vast areas throughout our country where the only material on which and from which roads can be constructed is clay.

At least two new bulletins are contemplated for the coming year—one on the cementing value of road materials and the other on the uses of concrete in road making.

The testing of cement and concrete in relation to road foundations, drains, and highway bridges will also be taken up and more tests will be made on paving bricks.

The present salary roll of the road material laboratory is as follows:

#### *Salaries of road material laboratory.*

Chief .....	\$2,500
Engineer .....	2,000
Chemist .....	1,500
Mineralogist .....	1,000
Machinist .....	900
Three assistants .....	1,920
Stenographer .....	720
Total .....	10,540

The allotment of funds for carrying on the work of this laboratory for the current year is \$10,000, this sum being a portion of that appropriated for Public Road Inquiries.

It can be seen from the above figures that the salary roll of the laboratory alone consumes more than the total allotment; but, as the work is being carried on in collaboration both with the Bureau of Chemistry and the Office of Public Road Inquiries, an arrangement has been made whereby the current expenses of the year can be met. The work, however, is growing so rapidly that it is most essential that an increased allotment be made for the fiscal year ending June 30, 1905, namely, \$15,000.

#### THE DRUG LABORATORY.

The character and scope of the work for next year has been outlined as follows: The chemicals for the laboratories will be examined as they are delivered by the manufacturer. Samples of the best quality of chemicals have been ordered and it is intended to establish a standard for chemical reagents. The potent drugs of the market will also be investigated to ascertain their quality and at the same time establish a standard for such articles. The quality of drugs imported into this country will also be considered.

Arrangements have been made with the chief of the insecticide and agricultural water laboratory to undertake a joint investigation of some chemicals, with a view to determining the amount of arsenic content in them and how it is introduced.

It is also intended to secure the cooperation of a number of pharmaceutical chemists in this country to work in unison for the purpose of making a careful study of the principal available analytical methods, and in this manner to determine which will give the best results.

The expenses for the fiscal year ending June 30, 1905, will be approximately as follows:

#### *Estimate of expenses for drug laboratory.*

Chief.....	\$2, 500
Assistant chemist.....	1, 000
Two scientific aids, at \$480 .....	960
Clerk.....	400
Chemicals and apparatus.....	1, 000
Samples and incidental expenses .....	1, 000
Total .....	6, 860

#### CLERICAL WORK.

The clerical work for the next fiscal year will be along practically the same lines as during the present year, but much more extended. It is desired to perfect the system of recording the results of the analytical work so as to make them available for ready reference.

The growth of each laboratory, as well as the addition of new laboratories, and the necessity of properly executing the food laws and carrying on the food adulteration experiments make it imperative that the clerical force be augmented in order to properly conduct such work and promptly and efficiently record and report its results. To this end, I recommend the appropriation of \$2,000 for additional clerical help.

## EDITORIAL WORK.

It is the intention, beginning with July 1, 1903, to keep a card catalogue record of the printing work of the Bureau, showing the progress of all work through the press, the issuance and distribution of bulletins, and to file samples of all job work, keeping a card index of the same. As the results of considerable cooperative work are awaiting compilation (including experiments on wheat, muskmelons, beets, etc.) and several important bulletins on methods, etc., need revision, there is urgent need of an additional editorial clerk to assist in the compiling and comparing necessary to accuracy in preparing such reports for the press.

The additional work of an editorial nature involved in the execution of the pure food laws is another matter of great importance. It relates especially to the preparation of circulars to agents of the Department charged with collaboration in the execution of the law, and especially the preparation and perfection of circulars issued in collaboration with the Department of Agriculture by other Departments, viz, the Treasury and the State Departments. The collection and publication of the decisions of the courts respecting the execution of food laws is also of the greatest importance in this line of work. An additional editorial clerk at \$1,200 is therefore recommended.

## LIST OF SKILLED ASSISTANTS.

The Bureau of Chemistry perhaps suffers more in proportion to the total number of its members than any other Bureau or Division of the Department from incursions into its ranks from other scientific institutions. From the 1st of January, 1903, to the 30th of June, inclusive, this Bureau lost by resignation the services of three chiefs of laboratories, viz, Mr. E. E. Ewell, chief of the contracts laboratory and assistant chief of the Bureau; Mr. E. G. Runyan, chief of the fertilizer laboratory; and Mr. W. H. Krug, chief of the dendrochemical laboratory. In addition to this, the chief of the sugar laboratory has requested that he be relieved after the present year from the duties of that position and be appointed a special agent of the Department for the time which he can give to its service, making in all a loss of four chiefs of laboratories in six months. In addition, other members of the force have resigned to accept more lucrative positions in other institutions. In all cases these resignations have been for the purpose of accepting more lucrative and promising positions either with public or private institutions.

It is evident, therefore, that if the Department of Agriculture wishes to retain the services of young men who distinguish themselves in their particular lines the compensation for these services must be increased. With the exception of the chiefs of laboratories, it is a matter of common record that the scientific assistants in the Bureau of Chemistry are not paid any more than is given for ordinary clerical services; yet, in order to discharge the duties of a scientific assistant, it is necessary not only that a college training be secured, but also a special professional training. Thus, the young man comes to the service of the Government after from four to six years of professional studies, and if he develops the tact, the industry, and the ability to command the attention of other institutions and of private



parties and corporations, it is evident that he can not afford to remain in the service with no prospect of a larger compensation than is given for clerical services throughout the Departments of the Government.

### THE ESTIMATES FOR 1905.

In the estimates for 1905 I have included the amounts which, it seems to me, are necessary for the faithful prosecution of the work under the various lines of investigation which this Bureau has established. I desire in addition to call attention to the necessity of obtaining an appropriation whereby the collaborators in the agricultural experiment stations engaged in the study of important problems, under the direction of the Bureau of Chemistry, may receive some compensation. About 25 stations now collaborate in these experiments, and a grant of \$200 for each one would not seem extravagant. On the contrary, it would be only a poor compensation for the amount of labor and time given to the work. I therefore submit an estimate of \$5,000 for this collaborative work.

To properly execute the pure-food law we not only need, as we have already received, the cordial collaboration of the Department of Justice, the Treasury Department, and the Department of State, but we need an additional fund to enable representatives of the Bureau to be present at the taking of samples, to inspect the cargoes in bulk, and especially for the purpose of sending experts to certain localities where suspicious articles of food are prepared and from which they are shipped. It is only in this way that information of a practical nature sufficient to exclude misbranded and adulterated products can be secured. For instance, no chemical examination can determine whether or not a label correctly represents the place of manufacture. The difference between the chemical composition of a rare wine from one of the old chateaux of France and a very ordinary wine would not in all cases be sufficient to distinguish between them. Thus, to prevent gross imposition upon our consumers, it will be necessary to have experts visit the localities from which these wines and other food products come in order to verify the character of the labels. Congress has placed in the hands of the Secretary of Agriculture a means for protecting our people against the gross frauds which have been perpetrated upon them for so long a time by the introduction of adulterated, misbranded, and debased food products. It is only reasonable and just to ask from Congress now a sufficient sum to thoroughly execute this law.

In addition to this, Congress has authorized the inspection by the Secretary of Agriculture of food products intended for export, so that our foods can go to foreign countries with the same assurance of purity which we ask in those coming to us. This inspection requires chemical service, expense of securing samples, and often inspection of cargoes.

Thus, in order to properly execute the law relating to imported food products, and also that relating to exported food products, we need a sum sufficiently ample to lend effectiveness and validity to the acts of Congress. I therefore recommend that \$50,000 be given to secure the proper execution of these two laws.



## REPORT OF THE CHIEF OF THE BUREAU OF SOILS.

U. S. DEPARTMENT OF AGRICULTURE,  
BUREAU OF SOILS,  
*Washington, D. C., September 23, 1903.*

SIR: I have the honor to transmit herewith a report upon the work of the Bureau of Soils for the fiscal year ended June 30, 1903.

Respectfully,

MILTON WHITNEY,  
*Chief of Bureau.*

Hon. JAMES WILSON, *Secretary.*

### WORK OF THE YEAR, WITH RECOMMENDATIONS.

#### PROGRESS OF THE SOIL SURVEY.

The area surveyed and mapped during the fiscal year was 23,293 square miles, or 14,907,520 acres, an area just about equal to the total area previously surveyed since the beginning of the work four years ago.

This enlarged work has been accomplished in part by the organization of five new field parties on the 1st of March, made possible by increased appropriations by Congress, and partly by keeping the parties continuously in the field, moving to Southern areas in the winter. While considerable time was lost in some of the areas by reason of excessive rains, upon the whole the system has worked well and has materially reduced the cost per square mile. The work has been carried on during the year in 63 areas in 34 States and Territories, as shown in the following tables:

*Areas surveyed and mapped during fiscal year ended June 30, 1903, and the areas previously reported.*

State or Territory.	Work during 1903.	Work previously reported.	Total.	
	<i>Sq. miles.</i>	<i>Sq. miles.</i>	<i>Sq. miles.</i>	<i>Acres.</i>
Alabama.....	1,223	.....	1,223	782,720
Arizona.....	108	503	611	391,040
Arkansas.....	251	.....	251	160,640
California.....	1,959	1,962	3,921	2,509,440
Colorado.....	1,195	150	1,345	860,800
Connecticut.....	273	245	518	331,520
Florida.....	548	.....	548	350,720
Georgia.....	156	571	727	484,480
Idaho.....	678	399	1,077	689,280
Illinois.....	2,241	1,356	3,592	2,298,880
Indiana.....	387	.....	387	247,680
Iowa.....	576	440	1,016	650,240
Kansas.....	.....	464	464	297,600



*Areas surveyed and mapped during fiscal year ended June 30, 1903, and the areas previously reported—Continued.*

State or Territory.	Work during 1903.	Work previously reported.	Total.	
	<i>Sq. miles.</i>	<i>Sq. miles.</i>	<i>Sq. miles.</i>	<i>Acres.</i>
Kentucky.....	507	330	837	535,680
Louisiana.....	740	202	942	602,880
Maryland.....	487	2,147	2,634	1,685,760
Massachusetts.....	267	143	410	262,400
Michigan.....	30	828	858	549,120
Minnesota.....	233	.....	233	149,120
Mississippi.....	661	656	1,317	842,880
Missouri.....	751	168	919	588,160
Montana.....	.....	107	107	68,480
New Jersey.....	395	908	1,303	833,920
New Mexico.....	.....	129	129	82,560
New York.....	1,075	483	1,558	997,120
North Carolina.....	1,221	3,425	4,646	2,973,440
North Dakota.....	856	.....	856	547,840
Ohio.....	375	980	1,355	867,200
Oregon.....	386	.....	386	247,040
Pennsylvania.....	266	938	1,204	770,560
Porto Rico.....	.....	330	330	211,200
South Carolina.....	1,346	686	2,032	1,300,480
South Dakota.....	485	.....	485	310,400
Tennessee.....	.....	547	547	350,080
Texas.....	1,238	495	1,733	1,109,120
Utah.....	200	794	994	636,160
Virginia.....	1,143	1,604	2,747	1,758,080
Washington.....	51	459	510	326,400
Wisconsin.....	955	.....	955	611,200
Total.....	23,293	22,445	45,738	29,272,320

*Areas surveyed and mapped and cost of the field work during fiscal year ended June 30, 1903.<sup>a</sup>*

State or Territory.	District.	Area surveyed.	Cost per square mile.	Total cost.
		<i>Sq. miles.</i>	<i>Dollars.</i>	<i>Dollars.</i>
Alabama.....	Perry County.....	762	1.26	960.12
Do.....	Mobile area.....	461	3.96	1,825.56
Arizona.....	Solomonsville area.....	108	9.35	1,009.80
Arkansas.....	Stuttgart area.....	251	2.80	702.80
California.....	Imperial area.....	915	4.30	b 3,930.20
Do.....	Los Angeles area.....	570	3.01	1,714.30
Do.....	Indio area.....	234	2.12	496.08
Do.....	Santa Clara area (survey in progress).....	240	2.06	494.40
Colorado.....	Arkansas Valley.....	795	3.36	b 2,671.20
Do.....	San Luis Valley (survey in progress).....	400	2.58	1,032.00
Connecticut.....	Connecticut Valley (survey in progress).....	273	1.65	450.45
Florida.....	Gadsden County.....	548	3.04	1,655.92
Georgia.....	Fort Valley area.....	186	2.79	1,666.66
Idaho.....	Blackfoot area.....	370	1.56	577.20
Do.....	Lewiston area.....	308	2.15	662.20
Illinois.....	St. Clair County.....	435	.84	c 365.40
Do.....	Clay County.....	460	.37	b 170.20
Do.....	Sangamon County.....	866	1.39	c 1,204.00
Do.....	Knox County (survey in progress).....	480	1.09	c 523.20
Indiana.....	Posey County.....	387	2.29	886.23
Iowa.....	Story County.....	576	1.49	858.24
Kentucky.....	Union County.....	31	3.65	b 113.15
Do.....	Scott County.....	280	1.74	488.52
Do.....	Mason County.....	225	1.71	386.00
Louisiana.....	New Orleans area.....	100	2.66	266.00
Do.....	Onachita Parish.....	605	2.15	1,299.20
Maryland.....	Worcester County.....	463	1.53	706.15
Massachusetts.....	Connecticut Valley (survey in progress).....	267	1.65	440.55
Michigan.....	Oakland County (survey in progress).....	30	5.74	172.20
Minnesota.....	Marshall area.....	233	3.02	704.16
Mississippi.....	Smedes area.....	463	1.82	841.80
Do.....	McNeill area.....	198	2.55	504.90
Missouri.....	Howell County.....	751	1.08	b 811.06

<sup>a</sup> This includes the salaries of the men while in the area and their subsistence expenses, but not the cost of transportation to and from the area.

<sup>b</sup> The portions of these areas surveyed in the previous fiscal year were given in the last report.

<sup>c</sup> Of these amounts, \$1,174.71 was paid by the Illinois experiment station.

*Areas surveyed and mapped and cost of the field work during fiscal year ended June 30, 1903—Continued.*

State or Territory.	District.	Area surveyed.	Cost per square mile.	Total cost.
		<i>Sq. miles.</i>	<i>Dollars.</i>	<i>Dollars.</i>
New Jersey.....	Trenton area.....	395	2.16	a \$52.20
New York.....	Lyons area.....	515	1.52	785.20
Do.....	Long Island (survey in progress).....	560	1.84	1,030.40
North Carolina.....	Hickory area.....	488	1.46	b a 712.85
Do.....	Parmele area.....	236	1.80	424.80
Do.....	Mount Mitchell area.....	497	1.24	b 617.40
North Dakota.....	Grand Forks area.....	314	2.74	860.36
Do.....	Fargo area.....	432	1.00	c 433.28
Do.....	Jamestown area (survey in progress).....	110	1.07	c 117.70
Ohio.....	Columbus area.....	134	2.00	a 268.00
Do.....	Toledo area.....	241	.90	a 216.80
Oregon.....	Salem area.....	284	2.12	601.92
Do.....	Baker City area (survey in progress).....	98	4.44	435.12
Pennsylvania.....	Clinton County.....	278	3.55	986.86
South Carolina.....	Abbeville area.....	320	1.20	a 383.08
Do.....	Campobello area.....	426	1.64	698.64
Do.....	Darlington area.....	600	1.40	840.00
South Dakota.....	Brookings area.....	485	2.03	984.55
Texas.....	Brazoria area.....	565	2.20	1,244.07
Do.....	Nacogdoches area.....	97	8.02	778.00
Do.....	Lufkin area.....	99	6.02	595.98
Do.....	Jacksonville area.....	100	2.89	289.00
Do.....	Vernon area.....	277	2.50	692.50
Do.....	Woodville area.....	100	9.28	928.00
Utah.....	Provo area (survey in progress).....	200	4.31	862.00
Virginia.....	Albemarle area.....	868	1.74	1,509.44
Do.....	Norfolk area.....	303	3.07	929.50
Washington.....	Walla Walla area.....	51	4.90	a 249.90
Wisconsin.....	Janesville area.....	451	1.67	752.40
Do.....	Viroqua area.....	504	1.70	856.80
Total, 34 States, 63 areas.....		23,300	2.19	51,136.60

a The portions of these areas surveyed in the previous fiscal year were given in the last report.

b Of these amounts, \$485.64 was paid by the North Carolina department of agriculture.

c Of these amounts, \$88 was paid by the geological and agricultural survey of North Dakota.

#### RECAPITULATION.

Cost of field work.....	\$51,136.60
Supplies.....	1,901.59
Traveling expenses between areas.....	5,215.76
Other expenses.....	5,059.56
Total cost of soil survey.....	63,313.51
Paid by State organizations.....	1,748.35
Paid by Department of Agriculture.....	61,565.16
Area surveyed.....	square miles..... 23,300
Cost of work in field per square mile.....	\$2.19
Transportation, supplies, and other expenses per square mile.....	\$0.52
Average total cost per square mile.....	\$2.71
Average cost to Department of Agriculture per square mile.....	\$2.63

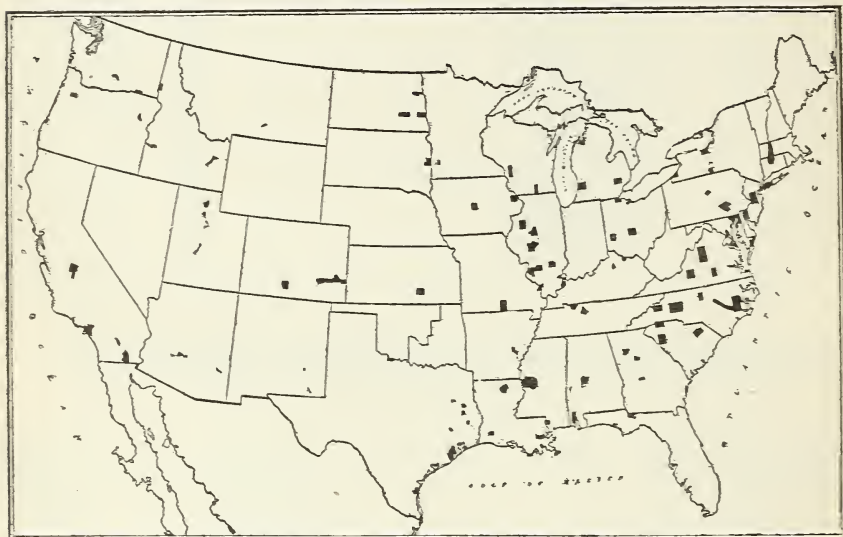
The cost of work in the field has increased from \$1.83 per square mile, as reported last year, to \$2.19 per square mile. This is due in part to increased salaries, necessitated by the fuller experience of the principal assistants, and in part to a large amount of rainy weather in the winter, which raised the cost in some of the southern areas very considerably above the average.

On the other hand, the advantage of keeping the men out, in spite of the delays from the winter rains, is seen in the reduced cost per square mile where all expenses chargeable to the soil-survey work are included. Last year the average cost to the Department of Agriculture was \$2.81 per square mile, and this year the total cost is \$2.63 per square mile. It is probable that this is the lowest cost that can be reached, and from now on the cost may gradually increase somewhat,

owing to the increased salaries which it may be necessary to pay our experienced men to hold them in the service.

There has been a great demand for these men from colleges and experiment stations and in private enterprises, but it has been the desire of the Department to keep the men at least five years in the soil survey, after which it is believed they will have had as much experience as they can get from such service, and they should then be prepared to take up special lines of investigation, or be ready to enter into positions of responsibility in educational institutions where soil investigations are being built up.

Although a total of \$61,565.16 was spent by the Department for the soil-survey work and \$1,748.35 by State organizations cooperating, and 63 areas were surveyed and mapped, with an average of 369 square miles each, we were unable to cover more than half of the areas in



Areas covered by the soil survey to June 30, 1903.

which surveys have been requested, and we have on file requests for nearly two years' work with the number of parties available with our present appropriations.

#### BRIEF SUMMARY OF THE RESULTS OF THE SOIL SURVEY.

The following gives very briefly the results of the work in the several areas:

##### ALABAMA.

During the last fiscal year two surveys were completed in Alabama—one covering Perry County, comprising 762 square miles, and the other part of Mobile County, with an extent of 461 square miles. This work was in charge of Mr. R. T. Avon Burke. Six types of soil were found in Perry County, one of which, the Orangeburg sandy loam (a type found also in several other areas in the South), promises to be very important as the basis of a new tobacco industry—the growing of the Cuban filler leaf.



In Mobile County five soil types were established. This area, while one of the earliest settled in this part of the country, is still largely undeveloped agriculturally, lumbering being the principal industry. The investigation of this part of the State was undertaken to determine the present status and possible extension of the fruit and early truck industries.

During the present field season the Bureau purposes to survey one area around Huntsville and one in the vicinity of Fort Payne.

## ARIZONA.

The Solomonsville area, Arizona, comprises one of the few important agricultural districts in the Territory. The area covers 108 square miles lying along the Gila River, from which is drawn the water for irrigation. The condition of the district as regards alkali is much better than in the case of many irrigated districts of the West, and the condition of the farmers is, on the whole, prosperous. Alfalfa and other general farm crops are the mainstay of the agriculture, while stock raising is an important adjunct. Some interest is taken in fruit growing and trucking, and there is excellent opportunity for the extensive production of apples, truck, and sugar beets on some of the seven types of soil found in the area. The prices of agricultural products are high, and the markets and mining towns of the Territory consume the greater part of the present output. The survey of this area was made by Mr. Macy H. Lapham.

## ARKANSAS.

The Stuttgart area, 251 square miles in extent, forms the only survey made in Arkansas during the year. But three types of soil were established, all having quite similar characteristics and obviously the same original derivation and composition. The agriculture of this area is general in character, the chief products including oats, corn, cotton, and hay. Large quantities of wild hay are baled for shipment. Stock raising and fattening is an important industry. Greater diversification of crops and the production of more of the necessities of life on the farm are suggested improvements in the present farm practice. The work in this area was carried on under direction of Mr. J. E. Lapham.

It is planned to make one other survey—covering Miller County—in this State during the present field season.

## CALIFORNIA.

Very important work was done in California during the last fiscal year. Two areas in the Colorado Desert, extending the work done around Imperial in 1901, were completed. The larger of these, the Imperial area, covers 915 square miles of territory, the lands of which are in the main badly alkaline. As this land is being exploited for settlement, the value of the work of the Bureau in aiding prospective purchasers to make a wise choice of location and in cautioning those already entered upon lands against careless methods of irrigation and farming, that might soon result in a total loss of their investments, can not be overestimated.

There are seven different soils in the Imperial area and five in the Indio area. These are all fertile, and were it not for the alkali could all be very profitably cultivated. The irrigation water for the Imperial

area is brought in from the Colorado River, a distance of about 60 miles. The irrigation system, which is, as might be inferred, an extensive and costly one, is yet in course of construction. The water is of very good quality and carries a large proportion of sediment, which is rich in plant food.

While the conditions in the Imperial area are undoubtedly grave, it is the belief of the Bureau that through cooperation of the owners of the land a system of irrigation and underdrainage could be installed that would enable the permanent reclamation of the worst affected alkaline land. Owing to the heavy texture of the soil and subsoil over a great proportion of the area, and because of the comparatively level surface, the problem presents more than the usual difficulties involved in such reclamation work.

The Indio area comprises only 234 square miles, and the conditions are, in general, somewhat better than in the Imperial country. The irrigation water is drawn from the mountain canyons and from artesian wells.

A large party equipped with camp outfit was engaged in this work in the desert throughout the winter. Mr. J. Garnett Holmes was in charge of both these surveys.

Another area, containing 570 square miles, was surveyed by Mr. Louis Mesmer around Los Angeles, in southern California. The soil system here is very intricate and eighteen distinct types were mapped. The agricultural industry is as varied as the soils, and includes the growing of the citrous, deciduous, and small fruits, alfalfa, barley, sugar beets, beans, truck, flowers for seed, and many special crops of less importance. The alkali problem in this area is relatively of less concern than in some other of the irrigated districts of the State, but there is need for systematic reclamation of more or less unproductive areas and for the protection of menaced lands. Altogether this is a thriving district.

In addition to the areas already mentioned work is now in progress in an area around Santa Clara. So far about 240 square miles have been surveyed, but it is too early to summarize results. This work is being carried on by Mr. Macy H. Lapham, who after finishing this area will take up work around Sacramento. Mr. J. Garnett Holmes will have charge of a survey of an area extending along the Colorado River from Needles to Yuma, Ariz. This work is being done at the request of the United States Geological Survey, being preliminary to the construction of an irrigation system by the Geological Survey under the recent Federal enactment providing for the reclamation of the arid lands of the West.

#### COLORADO.

In Colorado an important irrigated district in the lower Arkansas River Valley was surveyed. The area extends along the river from the Kansas line to Rockyford, a distance of 100 miles, and comprises 955 square miles of territory. Eleven types of soil, several of which could be correlated with types already established, were found in this area. They are rightly famed for their fertility.

Stock feeding and the production of alfalfa and sugar beets are important industries of the area. The famous Rockyford melons, shipped to markets in all parts of the country, are grown here. Fruit, honey, and vegetables are also leading products.

In the western part of the area the agricultural practices are more or less intensive and the industry is in a flourishing condition, but in the eastern part, owing to the recent unusual shortage of water, the outlook is not so bright and many abandoned farms are seen. Extensive systems for the storage of flood waters are now in course of installation, however, and conditions will improve materially as these are completed.

Besides the work in the Arkansas Valley, which was under the direction of Mr. Macy H. Lapham, a survey in charge of Mr. J. Garnett Holmes is being carried on in the San Luis Valley, situated in the southern part of the State. At the time of closing this report 400 square miles—about two-thirds of the entire area—had been completed.

## CONNECTICUT.

A large area in the Connecticut Valley, partly in Connecticut and partly in Massachusetts, will be surveyed during the field season of 1903. The work was begun in the last fiscal year, and up to July 1 273 square miles lying in Connecticut had been mapped. The survey is a continuation of the work done in the valley in 1899, and the purpose is to supply a basis for the intelligent extension of the shade-grown tobacco industry.

## FLORIDA.

A survey of Gadsden County, Fla., constitutes the work in that State within the last fiscal year. This survey, which was made in the interest of the producers of shade and open-grown wrapper and filler leaf tobaccos, was under the direction of Mr. E. O. Fippin. A great part of the tobacco produced in the State comes from Gadsden County, and all the conditions favor a great extension of the industry.

## GEORGIA.

The work in Georgia during the last fiscal year has been limited to a survey of a small but important area in the fruit district around Fort Valley. The work was done by Mr. W. G. Smith. But six types of soil were found, all of them met in earlier surveys. The area is particularly noted for the production of peaches.

## IDAHO.

Two surveys—the Lewiston area, covering 308 square miles, and the Blackfoot area, covering 370 square miles—were completed during the last fiscal year in Idaho. In the first-named area the work was in charge of Mr. Louis Mesmer. The area lies principally in the famous Palouse wheat region, but with the decline in the yield of wheat the need for diversification of crops is being felt, and the survey was principally for the purpose of studying the soils as adapted to the growing of forage crops and the introduction of dairying and stock raising. There seems to be every reason to predict a success for this industry and to encourage the farmers to embark in it to a greater extent than they have so far done.

The Blackfoot area is an important irrigated district and the work there, under direction of Mr. W. E. McLendon, was still in progress on July 1.



## ILLINOIS.

As announced in the annual report of the Bureau for 1902, the work of cooperation with the Illinois experiment station has been continued during the past year, and a party will be kept in the State during the remainder of the field season. This work has been under the direction of Mr. George N. Coffey. Surveys of St. Clair County, 435 square miles; Clay County, 460 square miles; Sangamon County, 866 square miles, and 480 square miles in Knox County have been completed. These surveys cover some of the richest agricultural sections and some of the less prosperous parts of the State, and the reports and maps submitted by Mr. Coffey convey, it is believed, many valuable suggestions, both to the farmers on the land and to those contemplating embarking in agricultural pursuits.

Besides the completion of the Knox County survey, soil maps of Winnebago, Johnson, and McLean counties will be finished during the remainder of the present field season.

## INDIANA.

Mr. Herbert W. Marean completed a careful and valuable survey of Posey County, Ind. Posey County was once looked upon as a very undesirable section of the State, but to-day the agriculture is in a remarkably prosperous condition. The 11 types of soil found here have a wide range in texture, and over by far the greater part of the area are very fertile, being derived from loessial material. General agriculture mainly is practiced. Suggestions for the introduction of certain specialties and the extension of others, based upon a study of the adaptation of soils to crops, are among the valuable results of this work. The work in this State will be continued during the present field season by a survey of Madison County.

## IOWA.

The work of the soil survey in Iowa has been continued by mapping Story County, situated in about the geographical center of the State. The area of this county is 576 square miles. Six soil types were found, one of which, a friable, sandy loam, covers over 80 per cent of the entire area. Story County lies in the great corn belt of the West, and corn forms the most important crop. Stock raising is a prominent industry. Dairying is well adapted to the climate and soils and is yearly becoming a more general pursuit. The soils of the area have many special adaptations which are practically undeveloped.

Upon the completion of the Story County area, Mr. Marean and party proceeded to Cerro Gordo County, Iowa, a survey of which will be completed within the present field season.

## KANSAS.

No soil survey was made in Kansas during the last fiscal year, but surveys of two areas are projected for the current field season, namely, around Parsons and Russell.

## KENTUCKY.

In Kentucky, surveys have been made of Scott County, area 280 square miles, and Mason County, area 225 square miles. This work

was in charge of Mr. R. T. Avon Burke. In the former county but three soils were found, all types that had been established in other areas. In Mason County there are seven distinct types. Both these counties are important producers of Burley tobacco and the surveys were made principally as a basis for a study of the condition of this important tobacco industry.

## LOUISIANA.

Four surveys were projected for Louisiana during the field season of 1903, two of which, together covering 740 square miles, were completed within the last fiscal year. The work in this State is being done in cooperation with the Louisiana experiment station, the field party being in charge of Mr. Thomas D. Rice. The Ouachita area covers 640 square miles in the central-northern part of the State. Nine soil types were established for this area, all but two of them new types. The principal industry is cotton growing, and although the soils and climate invite specialization in other lines the ruling high price of the staple at present discourages experiments with other crops. The other area finished within the fiscal year lies in the vicinity of New Orleans, and areas yet to be surveyed during this field season will also be in southern Louisiana.

## MARYLAND.

A survey of Worcester County constitutes the work of the Bureau in this State. The area comprised 463 square miles, and ten distinct soils, all types already established, were mapped. This work, which was done by Mr. F. E. Bonsteel, in cooperation with the Maryland geological survey, is an important addition to the work previously completed in this State, and should prove as fruitful of valuable suggestions as did the earlier surveys.

## MASSACHUSETTS.

The work in Massachusetts has consisted of an extension of the area surveyed in the Connecticut Valley in 1899. The work is still in progress at the time of closing this report, but 267 square miles had been completed on July 1. As in most glaciated regions, there are many soil differences in this area, and the soil arrangement is intricate and renders the construction of an accurate map more than ordinarily difficult.

## MICHIGAN.

Work in Michigan was begun about the end of the fiscal year, only 30 square miles having been covered up to July 1. It is the purpose of the Bureau to survey a portion of Oakland County during the present field season. As in Allegan County, the soil types are numerous and their arrangement very intricate, and the survey will of necessity be slow and tedious. The work is being carried on by Mr. H. J. Wilder.

## MINNESOTA.

The initial soil survey in Minnesota was completed within the last fiscal year. The area consists of 233 square miles in Lyons County, which lies in the southwestern part of the State. Mr. H. J. Wilder was in charge of this work. Nine types of soil were distinguished. Ninety per cent of the entire area is occupied by clay loams and loams.

This area is another in which the continuous cropping of wheat without fertilization, rotation, or thorough cultivation has decreased the yield per acre, and in which the need for other crops and improved methods is beginning to be felt. Corn is already grown more extensively than formerly, and the acreage is increasing from year to year at a phenomenal rate. It was formerly thought that corn would not mature within the short growing season of this part of the country, but by using a small, quick-growing variety very little loss is occasioned by frost. As supplying winter forage and enabling the wintering of more live stock it will be a valuable factor in restoring the lands to a higher state of productiveness. Dairying is also becoming a thriving industry. In studying the adaptation of soils to crops a marked relation between the grade of wheat and the soil producing it was found to exist.

## MISSISSIPPI.

Two areas were surveyed in Mississippi, the work being in charge of Mr. W. G. Smith. The Smedes area is the larger, containing 463 square miles, adjoining the area surveyed in the Yazoo delta in the preceding year. The types of soil were the same in the two areas, and embrace some of the best cotton lands in the State. Attention is called to the vast areas of undeveloped and flooded land of unsurpassed fertility lying in this region and only awaiting capital to become productive. Valuable suggestions have been drawn from a study of the agricultural practice and an opportunity for the introduction of stock raising and other industries suited to the soils and climate has been pointed out. At present the cultivation of cotton is the sole dependence of the farmers.

The McNeill area comprises 198 square miles in southern Mississippi, lying about 20 miles from the Gulf. The country has not been developed agriculturally, and lumbering, charcoal burning, and turpentine distilling are the chief industries. Six types of soil were found, the greater proportion of the area being occupied by sandy loams. Cotton is the chief crop, but the future development logically lies in the production of fruits and early vegetables.

## MISSOURI.

The first soil survey in Missouri, covering Howell County, with an area of 919 square miles, was completed during the last fiscal year. The work was in charge of Mr. E. O. Fippin. But three types of soil were found in the area. The country is rough and in some places rugged, forming a part of the geological district known as the Ozark Uplift, which covers a large territory in Missouri and Arkansas. The soils are stony, but well adapted to fruit growing, an industry that has already made considerable advance in the region and is capable of great extension. It is thought this survey gives a key to the soil conditions throughout the Ozark Uplift. It is the purpose of the Bureau to extend the work in this State during the present field season by a survey of Shelby County.

## NEBRASKA.

During the fiscal year just ended no survey was carried on in Nebraska. Two areas in this State, however, will be mapped before the close of the current field season, namely, around Grand Island and Norfolk.



## NEW JERSEY.

During the last fiscal year the work previously begun in the Trenton area, under direction of R. T. Aron Burke, was completed. The area covered has an extent of 810 square miles, and lies partly in the Piedmont Plateau, but chiefly in the Coastal Plain. It has a variety of soils and a no less varied agriculture. Fifteen different types of soil were mapped. All of these have been previously found, either in New Jersey or some other of the Middle Atlantic States.

## NEW YORK.

The work of the soil survey in New York has been confined to two areas—the Lyons area, comprising 515 square miles, in Wayne County, and the Long Island area, which was not completed until after July 1 last. The Lyons area lies in the heart of the apple country, in the western part of the State, but it was particularly in the interest of the beet-sugar industry that this survey was undertaken. Nine types of soil occur in this area, and the distribution is unusually intricate, making the survey work very difficult. This work was in charge of Mr. W. Edward Hearn.

The Long Island survey was in charge of Mr. Jay A. Bonsteel. The original plan was to make a survey of the entire island, but it was found that no accurate base maps for the eastern part could be obtained, and it was decided to postpone this part of the work until next season, when United States Geological Survey topographic sheets will be available. The work for the present season was a little more than half done on July 1. The area is known to be one of the leading trucking areas on the Atlantic seaboard, and the full report will contain much information of value to those operating in this line of agriculture in areas where the practices are less advanced.

## NORTH CAROLINA.

The work of cooperation with the North Carolina department of agriculture in the soil survey of this State has continued during the last fiscal year. During that time two areas, the Hickory and the Mount Mitchell area, both situated in the western Piedmont and mountain part of the State, were completed. Seven types of soil were found in the former area. Some of these, lying in the Piedmont country, are used for general farming, while the remaining types lie in the mountains and are suited to the production of fruit. Some advance is being made in the introduction of this industry. Several of the soils in the Mount Mitchell area (there are six types in all) are also particularly interesting because of their special adaptation to the production of apples and peaches, and it is only a question of time when the development now progressing so rapidly on identical soils in Virginia will extend to these soils of North Carolina. The survey of these two areas was in charge of Mr. Thomas A. Caine. During the present field season it is the purpose of the Bureau to complete work begun last year in the eastern part of the State, where the work has been delayed by the lack of accurate base maps. Another survey will probably be made in this State during the present season. This will be known as the Saluda area, and will include that portion of the State lying between the Mount Mitchell survey on the north and the State line on the south.

## NORTH DAKOTA.

The first work in North Dakota was undertaken in the last fiscal year. Two areas, comprising 746 square miles, were completed, and a third was partially surveyed within the year. The areas lie in the famous Red River Valley wheat region, where declining yields are bringing to the front the questions of new crops and new methods of cultivation. The surveys have been made to furnish a basis for a careful study of the reasons for the decreasing yield of grain, with a view to discovering the best means of bringing the soils back to their normal productiveness. Mr. Charles A. Jensen made the survey of the Grand Forks area, establishing six types of soil, three of which were correlated with the fertile Miami series of the Middle Western States. In the Fargo area there are eight distinct types of soil. Mr. Thomas A. Caine had charge of the work in the Fargo area and in the Jamestown area. The latter and probably one other survey in the State will be completed during the remaining months of the current field season.

## OHIO.

During the last fiscal year two surveys begun in the year preceding were completed in Ohio. The work was in charge of Mr. W. G. Smith. In the Columbus area, which lies around the city of that name, 134 square miles were surveyed, and in the Toledo area 241 square miles. The total extent of the two areas is 875 square miles. The soil system is simple, there being but four types in the Columbus area and five in the Toledo area. Some of these soils are very fertile, have a wide distribution, not only in Ohio, but throughout the Middle West, and are the ideal wheat and corn soils of the region. To be productive, wide areas have had to be drained, and the reports of these surveys make very suggestive reading for the agriculturists of less developed areas.

The work in Ohio will be extended during the present field season by a survey in Ashtabula County.

## OREGON.

The last fiscal year also saw the beginning of the soil survey in Oregon. Under direction of Mr. Charles A. Jensen, the Salem area, containing 288 square miles, was completed, and 98 square miles in the Baker City area had been mapped up to July 1, the area having been finished later in the same month. The soil of the Salem area is very uniform, there being but four distinct types. The adaptation of these to the different crops seems to be well understood by the farmers. The products of the area, which include as of chief importance wheat, apples, prunes, and hops, are noted for excellence of quality.

## PENNSYLVANIA.

The soil survey in Pennsylvania was extended by a party in charge of Mr. J. O. Martin, which made a map covering 266 square miles in Clinton County. Eight types of soil, all correlated with established types, were found in the Lock Haven area. General agriculture prevails, the one special crop being tobacco, which is not very important and is yearly decreasing in acreage. The cause for the falling off in the production of this crop is not due to any deficiency in the soils,

which produce a leaf of good quality, but rather, it is thought, to ruling low prices and increased production in areas where the industry is more concentrated.

## SOUTH CAROLINA.

On July 1, 1902, there remained 320 square miles yet to be surveyed in the Abbeville area. This and the Darlington area, containing 600 square miles, were completed in the early part of the last fiscal year. Six soil types were found in the Abbeville area, where cotton is the leading crop. In Darlington County a greater variety of soils is found. Ten distinct types were mapped. The agricultural industry is in a flourishing condition. The output of cotton and bright tobacco is large. Messrs. T. D. Rice and F. W. Taylor had charge of the work in these areas.

During the present field season, and within the last fiscal year, the Campobello area was completed. This area lies in the northwestern part of the State and comprises 515 square miles, partly in the Piedmont and partly in the mountain region of the State. In the latter we find the important Porters series of soils offering opportunities for fruit growing, while in the Piedmont occur the Cecil series of wide distribution on the Atlantic coast, of first importance as general farm types, and used probably as extensively as any soils for the production of cotton. A noticeable improvement is taking place in the farm practices of the area, but the rather rough country in the Saluda Mountains can not make much advance until better transportation facilities shall have been supplied.

## SOUTH DAKOTA.

The initial survey in South Dakota was made during the last fiscal year. The Brookings area lies in the central eastern part of the State and contains 485 square miles. Five types of soil occur in the area. Wheat and flax were the crops best adapted to the soils and early conditions of this part of the country, but while they are still the chief crops other products are yearly being grown more extensively. The agriculture of this area is in a flourishing condition. The survey was in charge of Mr. Frank Bennett, jr.

## TEXAS.

During the latter part of the field season of 1902 a survey was made of an important area in southern Texas. This work was in charge of Mr. Frank Bennett, jr. The Brazoria area contains 845 square miles, and this extent is apportioned among eight soil types. This survey was made in behalf of the fruit growers around Alvin and the sugar interests around Brazoria. There was formerly an extensive area of pear orchards in this part of the State, but these have been almost all destroyed by the blight. An important prospective industry is rice growing. Already some lands have been supplied with water for use in producing this cereal. There are large areas of a fertile soil well adapted to this crop that only need water to be as valuable as any rice lands in the country. The problem of procuring water is simple, although it will require the investment of considerable capital. The system used around Lake Charles, Louisiana, where the water is raised from the bayous successively into canals at different levels by means of centrifugal pumps, is the one best suited to the conditions in the



Brazoria area. Besides the staple crops, the area produces early vegetables and berries for the Northern markets.

In addition to the large territory covered by the Brazoria survey, work has been done in four areas, each about 10 miles square, in eastern Texas, where a soil peculiarly adapted to the production of a Cuban cigar leaf tobacco of fine aroma had been discovered through reconnoissance.

The work in the Woodville area was in charge of Mr. J. E. Lapham, and in the Lufkin, Nacogdoches, and Jacksonville areas in charge of Mr. W. Edward Hearn. Concurrently with the mapping of these areas experiments in growing selected plots of the Cuban leaf have been carried on, and the results seem to indicate the ultimate establishment of a very important tobacco industry in this region. It is purposed to continue the work in Texas by a survey of Lamar County.

#### UTAH.

The soil survey in Utah will be extended during the present season by the mapping of a large area in Utah County, just south of the Salt Lake country. On July 1 an area of 200 square miles had been completed. This was about half the area to be covered. No other survey will be made in Utah at present.

#### VIRGINIA.

Two areas, the Albemarle area, covering about 1,410 square miles in the Piedmont, mountain, and Great Valley sections of the State, and the Norfolk area, containing 303 square miles in the important trucking area near the seacoast, constitute the work completed in Virginia within the last year. The work in the former area was under direction of Mr. Charles N. Mooney. Covering, as it does, parts of three distinct physiographic divisions, the soil types are numerous, 18 different types being shown in the soil maps. Some of these soils, especially in the valley, are among the most fertile in the State, while in the mountain regions certain types at certain altitudes have recently acquired greatly increased value, because of the rapid extension of the apple and peach interests. The work done in this part of the area will be invaluable as a guide to investors in these industries.

Eight soil types, most of them sands or sandy loams, occur in the Norfolk area. The texture of these types, the prevailing climatic conditions, and the location with respect to rail and water transportation have brought about a phenomenal growth in the trucking and market-gardening industries in this area, and this careful and detailed study of the soils and agricultural practices should convey its lesson to those living in similar areas, of which there are many along the Atlantic coast, where these natural resources have not as yet been developed.

It is the purpose of the Bureau to finish within the remainder of the field season an area around Harpers Ferry. In a part of this area there are once productive soils that now yield scarcely at all, and one aim of the survey is to determine the reason for the remarkable change that has in such cases taken place.

#### WASHINGTON.

The only work the Bureau has done in Washington during the last fiscal year, excepting the alkali reclamation demonstration carried on

near North Yakima, consists of the survey of about 51 square miles at Walla Walla to complete the survey begun in the preceding year in that important wheat-growing section. This work was in charge of Mr. J. Garnett Holmes. Five types of soil were found in the area. A large proportion of the lands are hilly, and some so hilly as to make cultivation and handling of the crops very difficult. The staple products are wheat and barley, which are grown without thought of rotation, although the lands are summer fallowed. Along the streams small areas are used for growing vegetables and fruits under irrigation. There is some land in the valleys affected with alkali, but the excess is not great, and the reclamation of all such areas could be easily accomplished.

## WISCONSIN.

During the fiscal year two soil surveys were completed in Wisconsin. Mr. Jay A. Bonsteel was in charge of this work in the important tobacco district around Janesville. An area of 451 square miles was mapped and a number of new soil types established. Ten types occur in this area, several of which are peculiarly adapted to the production of a fine type of binder-leaf tobacco. There are many manufactories in the area, and the local market for all kinds of produce is good. Considerable quantities of sweet corn, cucumbers, cabbage, and other vegetables are grown for canning and pickling, and this industry is growing yearly. There are large areas of soils of varying textures, adapted to these different products, that can be most profitably utilized in this way.

The area in the vicinity of Viroqua covers 504 square miles. Here are found eight types of soil, mainly loams and sandy loams. This also is an important tobacco district, producing the binder leaf. The growing of small fruits is also a special industry, but a good part of the wealth of the farming class is the result of general farming and stock raising, both of which were important before the introduction of the special crops, fruit and tobacco. The survey around Viroqua was in charge of Mr. W. G. Smith.

## PUBLICATION OF THE REPORT AND MAPS.

In my last report I recommended a change in the method of publishing and distributing the reports on the soil survey. As the law now stands, in the joint resolution approved February 23, 1901, the reports have to be submitted to the Public Printer at one time and bound in a single volume, with the maps in an accompanying portfolio.

The Senate and House of Representatives together have 9,000 copies and the Department has 8,000 copies for distribution. This gives each Representative about 16 and each Senator about 32 copies—about enough for the public libraries and institutions in their respective States. In addition, the Department has usually ordered from 500 to 1,000 reprints of the report on each separate area, and has distributed these as far as they would go in the districts to which the work pertains. Besides being entirely inadequate to fill Congressional needs, this method of publication has the disadvantage of not meeting the local demands.

The principal value of this work lies in the suggestions it affords to the owners of land in the area, directing their attention to new crops and to better methods of agriculture. The bound copies that go to

libraries, public institutions, and prominent citizens are very well as works of reference, but for the utmost good to come of the soil survey copies of the separate reports and soil maps should be placed in the hands of a considerable number of people within the area surveyed, and our experience in the past has shown that there are from 500 to several thousand requests of this kind that the Department has not been able to meet. I therefore have the honor to recommend that in addition to the bound volumes already authorized, which hereafter may be published in one or more volumes, there be printed, as soon as the manuscript can be prepared, with the necessary maps and illustrations to accompany it, a report of each area surveyed, in the form of advance sheets, of which 500 copies shall be for the use of each Senator from the State, 2,000 copies for the use of the Representative for the Congressional district in which the survey lies, and 1,000 copies for the use of the Department of Agriculture. The reports could in this way be sent out as advance sheets from six to twelve months earlier than is now practicable, and could be distributed while the matter is still fresh in the minds of the people who have watched the progress of the field work. It would also supply the local demand, which is quite impossible with the present method of publication. Such a change in the method of publishing and distributing these reports will require Congressional action.

#### ALKALI RECLAMATION.

The Bureau of Soils has for a number of years past taken deep interest in the alkali soils of the arid portions of the West. Such soils have been encountered in nearly all of the surveys that have been made in the irrigated regions. The rise of alkali has been the cause of enormous depreciation in value of large areas of land and has worked great loss in discouraging further efforts in development. It is estimated that the depreciation in land values around Fresno during the last few years amounted to about \$1,000,000. The Central Colony, the site of the first development of agricultural industries around Fresno, was formerly considered the most valuable part of the district, but alkali has developed to such an extent that much of the once fertile land has been abandoned.

Between Salt Lake City and the Great Salt Lake, Utah, is an area of about 75,000 acres (120 square miles) upon which hundreds of thousands of dollars have been expended for agricultural purposes and in the construction of canals, railroads, and in laying out town sites. Practically all this money has been lost. Good crops have been raised for a year or two on some of the land and then the alkali has risen and the lands have finally been abandoned and used only as pastures. These matters had all been considered by the Bureau in the course of its soil surveys, and it was believed perfectly feasible to prevent these losses and to reclaim these alkali lands.

During the last year an opportunity was offered for sending Mr. Means, who has been in charge of the alkali work for some time, to Algeria and Egypt to assist Mr. Kearney in the collection of alkali-resistant seeds and plants. During the course of this trip Mr. Means collected very valuable information in regard to the methods of reclamation used on a very large scale by English capitalists in the valley



of the Nile. With the early method of depending upon the annual floods for irrigation, where the water was held on the land from four to six weeks, a single crop could be grown successfully, and for thousands of years the soils were cultivated in this way without damage from alkali. But the introduction of cotton, and the effort to raise two or three crops a year, requiring frequent irrigation, made it necessary to depart from this basin method and to introduce the perennial method of irrigation used in this country, where occasional smaller applications of water are made as the crop develops. This change in the method of irrigation is responsible for a large part of the damage from alkali that has taken place in recent years in Egypt.

The method of reclaiming these lands has been to construct numerous drainage ditches to carry off the seepage waters quickly and then to keep the land flooded for several months with from 4 to 6 inches or more of water. This water draining through the land and running off in the drainage ditches carries with it the excess of alkali salts, and in from one to three years even the worst alkaline soils are fully reclaimed.

There is a serious objection to the use of large open drains in this reclamation work, as they occupy an appreciable area of the land, interfere materially with cultivation, and are a constant expense to maintain. Tile drainage, as practiced in Ohio and Illinois, while the system is somewhat more expensive to install, is believed by the Bureau to be the more economical in the end. When once installed such a system lasts for an indefinite time, offers no obstruction to cultivation or irrigation, and requires a minimum amount of repairs.

In the summer of 1902 cooperation was entered into between this Bureau, the Utah experiment station, and Mr. E. D. Swan, who donated for a period of three or five years, for the purpose of experiment, 40 acres of land selected by the Bureau as typical of large areas around Salt Lake City. This land is part of a tract purchased by Mr. Swan a few years ago at \$8.50 an acre. A detailed examination of the soil made by the Bureau showed it to contain upward of  $2\frac{1}{2}$  per cent of alkali, or a total of 6,650 tons to a depth of 4 feet. The subsoil was very close and seemingly impervious to water. Tile drainage was established by the Bureau, and the land was flooded for a short time last fall, and this, together with the winter rains and snows, has maintained a nearly constant flow in the drains.

In May, 1903, another examination showed that about 49 per cent of the salt in the entire tract had been removed, and that about one-half of the area was sufficiently reclaimed to permit the growth of shallow-rooted crops. Twenty-nine acres out of the 40 contained less than 0.60 per cent of alkali in the surface foot. Thus nearly three-fourths of the tract was in suitable condition for any shallow-rooted crop that could stand abundant and frequent irrigations, and such a crop could have been planted without interfering with the progress of the work. We have experimented with a water grass (*Leptochloa fascicularis*) at Fresno, Cal., and have had most satisfactory results. This crop answers the same purpose as the dineba, or barnyard grass, does in the reclamation work in Egypt, but is a better hay and pasture grass and is better suited to American farming. Next spring, it is thought, most of the land can be seeded to some grain crop or alfalfa. However, to insure the complete reclamation of the land, the floodings were continued, and the slight advantage to be gained by putting in a grass crop was relinquished in the interest of the ultimate success of

the work. The spring work consisted of further leveling of the land and the construction of a better system of checks, so that the water could be maintained at a more uniform depth over the surface.

The drains are now running full much of the time. The irrigation water used contains about 100 parts of soluble salt per 100,000 parts of water, while the drainage water carries about 2,000 parts of soluble matter, equivalent to about a 2 per cent solution. The general appearance of the surface soil is much improved. A detailed alkali survey made October 15 shows that about 96 per cent of the surface foot contains less than 0.4 per cent of alkali. The second foot varies from 0.1 to 0.6 per cent, the third foot from 0.4 to 1 per cent, and the fourth foot generally has from 0.4 to 1 per cent or more. In October, 1902, the land carried on an average about  $2\frac{1}{2}$  per cent of alkali, while on October 15, 1903, the survey showed the removal of about 82 per cent of the alkali. A shallow-rooted crop can now be grown on most of the land and not interfere with further reclamation, provided a crop be selected which will permit the heavy flooding of the soil. The indications now are that by the end of the present growing season, or a little more than twelve months after the installation of the drains was completed, the land will be practically free from an excess of alkali. It will take until next spring, probably, to remove the alkali sufficiently to permit the continuous growth of alfalfa and other deep-rooted crops.

The following table gives the quantity of water added to the 40-acre tract and the amount of salt added in the irrigation water. The period covered extends from September 1, 1902, to September 1, 1903:

*Total quantity of water used in flooding and amount of salt added from this source in the experiment at Salt Lake.*

Date.	Water used.	Source of water.	Salt added.
	<i>Cubic feet.</i>		<i>Pounds.</i>
1902.			
September.....	284,400	Canal.....	24,000
October.....	940,000	.....do.....	83,900
November.....	171,300	Rain.....	
December.....	166,500	.....do.....	
1903.			
January.....	291,800	Rain.....	
February.....	136,400	.....do.....	
March.....	132,000	.....do.....	
April.....	112,000	.....do.....	
May.....	576,900	.....do.....	
Do.....	760,900	Canal.....	79,000
June.....	106,000	Rain.....	
Do.....	676,500	Canal.....	70,700
July.....	36,588	Rain.....	
Do.....	1,691,966	Canal.....	129,190
August.....	2,122,157	.....do.....	212,000
Total.....	8,305,411	.....	638,790

The following table shows the drainage from the Swan tract from September 1, 1902, to September 1, 1903, and the quantity of salt removed in the drainage water during that period:

*Total quantity of water carried off through the drains and the quantity of salt removed in this way in the experiment at Salt Lake.*

Date.	Drainage.	Salt removed.
1902.	<i>Cubic feet.</i>	<i>Pounds.</i>
September .....	158, 700	152, 200
October .....	265, 000	195, 100
November .....	251, 000	353, 800
December .....	139, 700	187, 600
1903.		
January .....	257, 300	391, 200
February .....	174, 400	214, 800
March .....	428, 000	590, 700
April .....	26, 900	26, 500
May .....	521, 500	567, 100
June .....	274, 500	345, 200
July .....	480, 490	556, 459
August .....	814, 890	1, 221, 742
Total .....	3, 792, 380	4, 802, 601

From the foregoing tables it will be seen that there has been added to this 40-acre tract 8,305,411 cubic feet of water, equivalent to 57 inches in depth over the entire tract, and of this quantity 3,792,380 cubic feet, or 45 per cent, was recovered in the drainage. This drainage water, equivalent to 26.2 inches in depth over the entire tract, carried 2,401 tons of salt. Should we consider the seepage water which has drained into the subsoil and not out through the drainage tile, it is likely that at least 4,000 tons of salt have been removed from the land.

The cost of putting in the tile drainage system was about \$16 per acre, notwithstanding the high price which had to be paid for tile, the inexperienced labor, and the cost of bringing drainage tools from the East. Fertile lands around Salt Lake City, which are at present not affected by alkali, are worth from \$100 to \$350 per acre. Land such as this, purchased for \$8 per acre, reclaimed at a cost for actual installation of \$15 per acre, and worth, even at a minimum estimate, \$75 or \$100 per acre, represents a very good business proposition, and there is a handsome profit to be made in an enterprise for the general reclamation of the damaged lands around Salt Lake City.

At Fresno cooperation was entered into between this Bureau and Messrs. S. M. Toft and N. H. Hansen on a tract of 20 acres of land in the Central Colony, which some years ago is reported to have been purchased for \$350 per acre. The land at the beginning of the experiment was so full of alkali, particularly black alkali, or sodium carbonate, that it was of very little agricultural value. A system of underground tile drainage was installed, at a cost of about \$15 per acre, and flooding was begun in the spring of this year, the water being held on the surface to a depth of about 4 inches as long as practicable with the limited water supply at command.

One of the difficulties to be met here was the rise of the seepage, or the underground water, and another principal difficulty was filling up of the drains by caving in of quicksand and the stoppage of the tiles by the washing of fine particles of silt between the joints of the tile. This difficulty has been met, and the drains have been running full and



carrying off a large proportion of the excess of salts. The indications now are that the excess of salts will be removed and the land be in condition for any crop of the district inside of two years, with the probability that shallow-rooted crops could be put in at the beginning of the second year if desired.

This tract is in the midst of the raisin-grape district, and land is valued at \$250 or more an acre. The economic importance of this work in the Fresno district alone can hardly be appreciated, and when it is remembered that this demonstration will serve equally as well for large areas in the San Joaquin Valley and other areas remote from this place the value of the demonstration to the people of the West fully justifies the small expense the Department will be under to carry the work to a close.

After the installation and the successful starting of the drainage work at Fresno the party went to North Yakima, where similar conditions prevail, land being affected with seepage waters and black alkali to such an extent that it is unproductive. At this point cooperation was entered into between this Bureau and Mr. P. Gervais on a tract of 20 acres. It was more difficult to obtain tile drain at this place than at Fresno, and the expenses of the work in consequence were considerably higher than at Fresno or Salt Lake City. The actual cost of the installation of the drainage system was about \$21 per acre.

Such a system has, however, been successfully installed. The land is being kept flooded with water, the drainage tiles are running full and free with water highly charged with alkali salts, and the indications are that the reclamation here will likewise be entirely successful, and that in the course of two years any crop suited to the locality may be grown.

The tract here consists of 20 acres having a merely nominal value, whereas after it is reclaimed and made again productive it will be classed with the more valuable lands of the locality, which bring \$150 or more an acre.

The various problems in connection with the work have been thus far satisfactorily handled as they arose, much valuable detailed information has been gained in both practical and scientific lines, and there is every reason to believe that the alkali reclamation demonstrations will be an entire success. Considerable interest has been created, and especially is this the case in the localities where the experiments are now being conducted, and the results thus far accomplished tend to prove that the plans adopted by the Bureau for the reclamation of alkali lands are not only practicable, but within the possibilities of the ordinary farmer, easily comprehended, and, most important of all, that the expense incurred is more than justified by the results secured.

The Bureau has made a point of examining the several localities where it has been working for clay suitable for drainage tile, and it is believed several good deposits have been found in each area. This clay is being tested now by practical tile makers. The ultimate success of the reclamation work will result in the extensive use of drain tile, thus opening up new fields for the establishment of tile factories in various places throughout the West. The local manufacture of tile will greatly lessen the cost of installation of the drains.

During the year the Bureau issued the following publications bearing on the question of alkali: A bulletin on the methods of alkali

reclamation in Egypt, a circular on the use of alkaline waters in irrigation in Algeria, and another giving a brief statement of the work at Fresno.

#### TOBACCO INVESTIGATIONS.

In my last report attention was called to the successful introduction of the shade-grown tobacco industry in the Connecticut Valley. In consequence of the satisfactory results obtained by last year's experiment, it was decided to leave a tobacco party in the Connecticut Valley for another year to help all those engaged in the growing of Sumatra tobacco under shade. A force of experts was assigned to this locality, and in cooperation with the tobacco growers a crop of about 700 acres was raised.

Headquarters were established at Hartford and the area divided into five districts—East Side, 54 acres; Suffield, 151 acres; Tariffville, 145 acres; Windsor, 159 acres, and Farmington, 108 acres; each of these districts being under the immediate charge of an assistant, whose duty it was to supervise the work of building the sheds and cultivating and harvesting the crops. The tobacco was set during the month of June; and although the season was an unfavorable one, it made remarkable growth, in most of the tents reaching to the cloth, a distance of 9 feet from the ground. Topping was begun during the latter part of July, and during the months of August and September the tobacco was harvested, and very little trouble was experienced during the process of curing.

The average yield of cured tobacco was 1,200 pounds to the acre, and the leaf was pronounced by experts to have all the qualities necessary for a cigar wrapper.

After being air-cured the tobacco was placed in warehouses provided by the local tobacco dealers and there bulk fermented and packed in Sumatra style under the supervision of the Bureau's expert and his assistants. Only a small portion of this tobacco has been placed on the market, but the prices obtained are very encouraging, ranging from \$1.50 to \$3.50 per pound for wrappers.

As a result of this work the area under shade has been increased to 1,000 acres, the Bureau, at the request of the growers, leaving an expert in the field to supervise the work. At present not much can be said concerning this later work, as the new crop is still in the curing sheds.

It is estimated that through the efforts of the Bureau resulting in the introduction of this new variety of tobacco and in modifications in the methods of cultivating and fermenting, \$1,000,000 were added last year to the value of the tobacco grown in the Connecticut Valley.

During the same time experiments were being carried on in two warehouses in Hartford, Conn., in bulk fermenting the native Havana seed tobacco. The old method of case force sweating and the natural case sweat, which are mostly used, are unsatisfactory both to the dealer and the manufacturer, thousands of dollars worth of tobacco being damaged every year by mold and rot.

In these two warehouses bulks containing from 3,000 to 4,000 pounds were made, and the temperature was not allowed to go higher than 115° F. This tobacco came through the fermenting process with light colors and no sign of damage of any kind. Most of the tobacco was

sold for 85 cents per pound, which is far above the price usually obtained by the packers of Havana seed tobacco. This experiment was watched by the dealers and packers, many of them expressing their intention of adopting the bulk fermentation of the Havana seed in the future.

While the wrapper problem was being solved in the New England States, the Bureau was undertaking an experiment in the production of filler tobacco in the Southern States. In the areas in which soil surveys were made in southeast Texas, Perry County, Ala., and Darlington County, S. C., certain types of soil were found that compared favorably with the celebrated tobacco soils of Cuba. Small samples of leaf grown on these special types of soils were obtained and submitted to experts in New York and Philadelphia, who pronounced the tobacco to be in the same class as Cuban leaf.

After receiving strong encouragement from men familiar with all the requirements of the tobacco trade, it was deemed advisable to carry on a series of experiments in the above-mentioned States to determine if the Cuban leaf having the fine aroma necessary for a filler could be grown. Accordingly, experimental fields were established at Nacogdoches, Tex., Marion, Ala., and Hartsville, S. C., each in charge of an expert in tobacco culture. When cured, these crops will be taken to Texas and there fermented, graded, and baled. After allowing the tobacco to age, samples of the various grades from each of the different crops will be submitted to the trade for its judgment.

Experiments are also being conducted in Ohio for the improvement of the flavor and aroma of the filler tobacco of that State. As a result of the soil survey made around Germantown, Mr. George B. Massey, one of the tobacco experts of the Bureau, was assigned to that locality to cooperate with some of the best growers in the raising of an experimental crop of Cuban tobacco. Arrangements were made with two tobacco planters to furnish the necessary land, implements, and curing sheds. A crop of 6 acres was grown, fermented, and baled under the Bureau's direction. The entire yield was 2,191 pounds of fermented tobacco ready for the cigar maker. This product has not been submitted to expert judgment, as it is not sufficiently aged.

Bulk fermentation experiments were also carried on in the local warehouses, where 655,200 pounds of the 1901 Zimmer Spanish were handled by the Bureau. Further fermentation experiments are being conducted this summer, and the Bureau has under its supervision in various warehouses 2,916,000 pounds of Zimmer Spanish, 1,000,800 pounds of Ohio seed leaf, and 288,000 pounds of Little Dutch, making in all 4,204,800 pounds of tobacco, which is an increase of 3,549,800 pounds over the quantity handled in last season's experiment. The Bureau has only a supervisory control in these experiments, the work being done by the packers, and the object in view is to encourage the use of better methods of fermentation, which, it has been demonstrated, will result in less loss from rot and imperfect curing and in better grades and higher prices for the cured product. It is believed from the result of this year's work that the methods introduced by the Bureau will be very generally followed hereafter in Ohio.

Recognizing the necessity of establishing a perfect type of Sumatra tobacco both in Connecticut and Florida, the office of Seed and Plant Introduction and Distribution of the Bureau of Plant Industry secured for this Bureau through Mr. Barbour Lathrop a small amount of seed



from the island of Sumatra. This seed was distributed to several responsible growers in Connecticut and Florida. These growers have planted 1 acre each in specially constructed tents, and selections were made by our expert from plants showing the truest type of Sumatra. From these selected plants, seed will be saved, a portion of which will be distributed to the shade growers of Connecticut and Florida.

As our experiments in Ohio, Texas, South Carolina, and Alabama deal with the introduction of Cuban filler tobacco, the following table will be of interest:

*Production and value of filler tobacco in 1901.*

Type.	Production.	Value.
	<i>Pounds.</i>	
Ohio .....	35,654,314	\$3,832,839
Pennsylvania .....	17,614,380	2,113,725
Other domestic filler.....	17,666,531	1,971,584
Total domestic filler .....	70,935,225	7,918,148
Imported Cuban, 1901.....	18,554,775	16,212,773

In the above statement the production of the domestic tobacco is on the basis of the fermented leaf, 20 per cent having been deducted from the total production for shrinkage in fermentation and loss in handling. In the case of Ohio the necessary allowance for other types than the filler types grown in the State has been made. Two cents per pound has been added to the value of the domestic tobacco to provide for the expense of fermentation, etc., thus putting the Cuban imports and domestic filler on the same basis. It will be seen from these figures that the Cuban imports, while only one-fourth as great in quantity, represent in the aggregate two and one-third times the value of the domestic product. It is therefore necessary for the American tobacco grower and packer of our filler States to alter their present methods of curing and handling if they are to command better prices for their product.

I would suggest that the filler experiments in the South be continued on broader lines, similar to those of the Sumatra experiments in Connecticut, and that the Bureau extend its operations into other States where the results of the soil survey show that tobacco can be raised or where improvements can be made.

#### WORK OF THE LABORATORIES.

Besides the routine work devolving upon the laboratories in aid of the other lines being prosecuted by the Bureau, they have been developing several special investigations in the physics and chemistry of soils. Much of their work is of a purely technical character, necessary to a proper understanding and handling of the large soil problems which the Bureau is investigating, but not in itself of immediate interest or value to the practical agriculturist. Some of the work, however, has such an immediate interest and is of such a far-reaching and fundamental character that it is believed worth while to give a brief description of it, referring to the regular publications of the Bureau for the technical details.

The two subjects of most practical importance to the farmers of the

country to-day are the distribution and yield of crops, and the Bureau has for a number of years past been urging upon the attention of the agriculturists of the country the importance of the adaptation of particular soils to crops in order to get the best economic returns. Investigations made by the Bureau during the last ten years have shown that the economic distribution of crops is dependent upon the physical characteristics of soils and the climate. The quality of a crop, which is now beginning to receive more attention in general agriculture, is yet a subject of importance only in some special lines, and it is recognized that it can be controlled by both physical and chemical methods. But the paramount question with the farmer to-day, and the one to which all his energies and resources must tend, is the yield of crops, and it has been popularly believed to be more or less directly influenced and controlled by the chemical characteristics of the soil. The Bureau has therefore made an exhaustive research of this latter subject, the results of which, with the conclusions based thereon, have been published in a recent bulletin. These investigations seem to necessitate an interpretation of the influence of the chemical characteristics of soils on the yield of crops somewhat different from that usually advanced, and to modify very materially as well as clear up our conceptions of this important matter.

In considering the question of the chemistry of the soil as related to crop yield it was deemed important to determine what amount and proportion of the several mineral plant foods were actually in solution in the soil at any one time, or from time to time, since it has been admitted by practically all authorities that it is the solution naturally existing in soils which is the immediate source of the mineral foods obtained by the crops growing upon them. Birner and Lucanus, as long ago as 1866, pointed out that plants can be grown to perfection in well water if suitable physical conditions are preserved, and, as a matter of fact, they grew oat plants in such water, renewed weekly, the yield of grain being double that from a rich garden soil. This well water contained in 100,000 parts 15.14 parts of lime, 2.13 parts of potash, 0.16 part of phosphoric acid, 7.45 parts of sulphuric acid, and 6.02 parts of nitric acid, so that the plant obtained all its needed phosphoric acid from a solution containing 1.5 parts of acid in 1,000,000 parts of water, a concentration probably less than that usually existing in the soil moisture. Johnson, in commenting upon this experiment in his classical work, says:

The analysis of the well water shows that the nutritive solution need not contain the food of plants in greater proportion than occurs in the aqueous extract of ordinary soil.

Until the work of this Bureau was undertaken it had never been possible to make a satisfactory study of this subject, owing to the difficulties encountered in isolating the natural nutrient solution from the solid soil and in analyzing this solution for the extremely small amounts of dissolved material maintained in it.

By careful work and unusual ingenuity these analytical difficulties have been surmounted by the Bureau and methods devised which enable us to obtain the soil solution and to estimate, with a degree of accuracy little short of marvelous, the amounts of the constituents contained which are of significance for plant growth.

Furthermore, it has been found possible to so develop the methods for the estimation of those constituents which have by popular con-

sent been regarded as of the most importance as plant foods and those which are subject to attempt at control by the art of mineral fertilizing, namely, phosphoric acid, nitric acid, potassium, and calcium, that by means of a small portable equipment parties can be sent to any area in which we desire to study the soil and analyze the soil solution or water extract of the soil within a few hours of the actual taking of the sample from its place in the field.

With these methods, added to the physical ones developed by the Bureau in the past, it has been found possible to examine hundreds of samples from day to day throughout the growing season on a number of our type soils, comparing not only the different types, but fields or areas within a type which are yielding, on the one hand, good crops and, on the other, indifferent or poor crops.

The results obtained in this work have satisfied us that the soluble mineral matters of soils produce in general a saturated or nearly saturated solution in the soil moisture; that is, that the mineral substances containing the lime, potash, and phosphoric acid, for example, are for the most part complex and but slightly soluble materials, of which only a small proportion could at one time be dissolved in an amount of water represented by the normal water content of soils. And the indications point to the fact that the potash, for instance, is not in general present as a common salt, such as the chlorid or sulphate, but exists probably in the form of a complex mineral not necessarily identical with any known mineral substance. It is recognized that exceptions do exist, and that there are soils which are probably composed of such a mixture of mineral substances as would yield a soil solution differing widely in character and concentration from that normally to be found in cultivable soils. Moreover, bacterial agencies, such as nitrifying organisms, ferments, etc., and local conditions, may be expected to produce unusual results. Such cases are, however, to be regarded as abnormal.

Briefly stated, the results appear to show, contrary to opinions which have long been held, that there is no obvious relation between the chemical composition of the soil as determined by the methods of analysis used and the yield of crops, but that the chief factor determining the yield appears to be the physical condition of the soil under suitable climatic conditions. It was clearly brought out that there are no wide variations in the amounts of material going into solution when various soils, so widely different in their other characteristics, are acted on by a definite proportion of water for a short but definite length of time. One is thus easily led to the view that all types of soils furnish about the same amount of plant food when treated with the same proportion of water, other conditions, as time, temperature, etc., being also the same. That this might have been expected from a priori considerations has been pointed out in an examination of the chemical nature of the mineral components of the soil, but the experimental confirmation brought out in this work is of the first importance in putting this idea on the basis of a working hypothesis for the direction of future investigations.

It is further evident from these deductions that a soil normally containing 20 per cent of water will have actually twice as much salt in solution as the same or a different soil having 10 per cent of water, although the solution in the two cases would be of about the same con-



centration. Furthermore, that if the amount of water were reduced through root action, the salt not being taken up as rapidly as the water, some of the salts might go out of solution, although in a form more or less readily soluble, provided there was sufficient water to dissolve them. It seems probable also, from our observations, that the movement of the water in the soil is much more rapid than the movement of salts contained in the water, as the surface influence of the soil grains upon the saline material, or what is generally recognized as adsorption, is sufficient to retard to a very great extent the movement of salts and make it a difficult and tedious process to leach the salts out by the continual passage of water.

It was obvious from the consideration of some hundreds of examinations with these new and exceedingly delicate methods that there is no apparent relation between the dissolved salt of the soils, as determined by the methods, and the yield of crops, and that there are no constant differences between the different types of soil, although these types differ widely in their agricultural values. With such small differences as were actually found, quite as often the larger amounts of plant food were found associated with the poorer crop, and vice versa, as that the amount of plant food should be in the same order as the yield; and, furthermore, the differences between the soils of various types with known wide variations in agricultural value, or soils of the same type supporting on the one hand good, on the other poor crops, were no larger than those found between soils yielding approximately the same crop.

On the other hand, many cases might be cited where the usual methods would indicate the inability of a soil to support vegetation, though as a matter of fact such vegetation does exist. In illustration, some analyses recently made in the routine work of the Bureau might be cited. These soils and subsoils from southern forest lands were reported as maintaining a good growth of oak and pine, and underbrush of hickory, chinquapin, and huckleberry, although the plant food "available," according to the official method, is exceedingly low. The analyses of the aqueous extract by the methods developed in the Bureau indicate that the soil solution is probably about normal in concentration as compared with other soils from humid areas.

From the results of the investigations the conclusion seems inevitable that all our principal soil types, in fact, practically all cultivable soils, contain naturally a nutrient solution which varies within comparatively narrow limits with regard either to composition or concentration and which is usually sufficient for plant growth. Apparently, therefore, all these soils are amply supplied with the necessary mineral plant foods, and these plant foods are not in themselves a matter of such paramount importance to the agriculturist, for their supply as regards the plant is determined by the supply of soil moisture which the crop can obtain from the soil. The chemical analysis of a soil can not in itself, therefore, throw much light upon the problem of fertility, but, when attempting to control the factors governing crop yield, attention must be directed to the mechanical condition of the soil as affecting the supply of soil moisture, with its dissolved mineral nutrients, to the effects of climate, to rotation, and to general soil management. These factors have all been thoroughly discussed in the bulletin mentioned from the new point of view presented here, but it seems hardly appropriate to present in detail such technical matters in this connection.

One point in connection with the fertilizer studies may, however, be properly cited, owing to widespread popular misconceptions.

If fertilizers have any influence upon the texture of the soil, or upon the movements of soil moisture, they will not only influence the supply of water which will be delivered to the plant, but also the supply of nutrient materials normally contained in this water. The problem would then come into the domain of soil physics rather than into that of soil chemistry. The important practical inference, if this is so, is that fertilizers have to a certain extent the same effect as cultivation and cropping; but in a majority of cases it is undoubtedly better to depend upon efficient methods of cultivation and cropping than to rely upon fertilizers, while at the same time neglecting to give proper attention to the physical condition of the soil. The effect due to cultivation is also more permanent than the effect due to fertilizers. Furthermore, the influence of fertilizers on the yield of crops is not proportional to the amount of fertilizers added, as it frequently happens that a small application is quite as efficient as a larger application.

Some time ago the Bureau of Soils was led to suggest, as the result of investigations, in part made in cooperation with the Bureau of Plant Industry, that possibly plants, like animals, needed a "balanced ration" for their best production. This idea is in apparent opposition to the generally accepted one, known as the "law of minimum," and generally attributed to the great agricultural chemist, Liebig, which supposes that the essential plant food present in the lowest proportion to the amount required will determine the development of the plant. The idea now held by the Bureau as a result of these investigations is that the ratio of the nutrient elements in normal soils does not play a very important part in the yield of crops, or, to be more explicit, low yields are usually related to the physical condition and characteristics of the soil, and that it is only after these major controlling factors are changed and the yields thereby increased that it would be necessary or profitable to consider this question of the ratio of plant foods. In other words, that it is only where all other conditions of plant nutrition and growth are satisfactorily controlled that the nutritive ratio can be considered an important factor, and that the influence of this would be mainly seen in the quality of the crop rather than in the yield. In this effect it is analogous to the feeding of animals for work, fat, flesh, speed, or endurance, all of which can be sensibly controlled by the nutritive ratio only if other more important factors of growth and development, such as environment, etc., have been given due consideration. From our investigations it does not appear that the low yield of 5 to 8 bushels to the acre on the Cecil clay of North Carolina as compared with the 25 to 30 bushels of wheat obtained from the same soil under better methods of cultivation can be due to a defective nutritive ratio in the first case, and that therefore this can not be in general an important cause of low crop yields, and that the subject of nutritive ratio can safely be put aside for the present as of relatively little importance to the farmer, however great its importance may be to the horticulturist and floriculturist under the intensive system of cultivation practiced in their special lines.

One of the commonest fertilizer practices, from early historical times to the present, is that of liming. The practice is now receiving a good deal of attention from investigators, especially in the Eastern United States. The rationale of this feature of soil management, as

well as the practice, is the subject of considerable discussion and some controversy. Lime has been shown to have very considerable effects upon both the physical and chemical properties of soils. It is held by some that its use is mainly for the purpose of preserving the proper balance between the plant food, calcium, and other plant foods, especially magnesium, and the Bureau of Plant Industry has published within recent years evidence in this connection. Others hold that its principal function is to neutralize soil acids and render the soil slightly alkaline, a condition supposed to be most favorable to the majority of crops, and especially adapted to the development of desirable microscopic organisms; while many hold that its principal function is to react chemically with the minerals in the soil, supposedly rendering potassium and phosphoric acid more soluble and therefore more readily available to plant food. On the other hand, the value and efficiency of liming has been questioned, it being held that lime in the forms more generally used tended to destroy or "burn out" the organic matter of the soil, thus injuring it both physically and chemically, while evidence has been adduced to show that its effects are quite superficial, since lime is but sparingly dissolved and but slowly distributed in the soil.

These points have been carefully considered in our laboratory studies, and while they have all been shown to have a basis in fact, their relative significance varies much with varying conditions and in different locations. A method for determining the lime requirements of soils was worked out, which is superior to any other yet proposed. Yet, it has only a conventional basis, and has been shown to be entirely inadequate to giving any true idea as to the presence or quantity of acid in the soil. Moreover, the work of the Bureau strongly indicates that very seldom are soil acids themselves present in harmful proportions, but they are rather attendant upon or "symptomatic" of unfavorable physical conditions. The previous experience of the Bureau in finding that the presence of other substances, but especially lime salts, reduced the harmful properties of noxious dissolved salts led to a thorough study of the effects of acids, when alone and in the presence of either potash or lime salts upon a number of our common crop plants of widely differing natures and habits. It was found that a comparison of a number of mineral and organic acids showed that they had individual specific actions, that both the amount and order of their action varied very widely with different plants. Their action was much modified and lessened by the addition of potash salts, and much more so by lime salts. A number of valuable observations were made of the stimulating action of very small quantities of substances which in larger amounts would prove noxious; the survival of individuals under conditions inimicable to the average plant, a matter of the first importance for plant breeders. But most important for soil studies, the quantitative order of these results would indicate the great improbability of the results as to soil acidity given by the conventional methods hitherto suggested. Some of the technical features of this work have already been communicated to the scientific world through appropriate channels. A bulletin is now in course of preparation which discusses this whole subject from the practical agricultural standpoint, and it is confidently believed that the work of the Bureau has very materially advanced this line of investigation, with consequent practical results.



## REPORT OF THE ENTOMOLOGIST.

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U. S. DEPARTMENT OF AGRICULTURE,  
DIVISION OF ENTOMOLOGY,  
*Washington, D. C., August 26, 1903.*

SIR: I submit herewith an executive report covering operations in the Division of Entomology for the fiscal year ending June 30, 1903, dividing it, in accordance with the directions contained in your circular letter of June 25, into the following sections:

(1) A brief review of the operations carried on during the fiscal year 1903.

(2) An outline of the plans proposed for the work of this Division for the fiscal year 1904 under appropriations already made for that year.

(3) Suggestions as to work recommended for the fiscal year ending June 30, 1905, for use in preparing estimates.

Respectfully,

L. O. HOWARD, *Entomologist.*

Hon. JAMES WILSON, *Secretary.*

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### WORK OF THE YEAR.

The work of the Division of Entomology during the past fiscal year may be classified as follows:

Work on insects from abroad.

Work on scale insects.

Work on the Mexican cotton boll-weevil.

Investigations of insects damaging forests.

Work on the codling moth in the Northwest.

Investigations of insects injurious to truck crops.

Work on insects injurious to stored products.

Work on insects affecting ornamental plants.

Work in silk culture.

Apicultural investigations.

Experimental work with insecticides.

Investigations of insects in their direct relation to the health of man.

Work on insects injurious to shade trees.

Unclassified work on injurious insects.

Work on the geographical distribution of injurious insects in the United States.

Technical work.

Bibliographical work.

Correspondence.

## WORK ON INSECTS FROM ABROAD.

## THE ASIATIC LADYBIRD ENEMY OF THE SAN JOSE SCALE.

A rather complete statement was made in the report of last year on the status and future outlook of the *Chilocorus similis*, the ladybird enemy of the San Jose scale, found in China and Japan and imported into this country to attack this scale insect on our deciduous fruit trees. During the late summer of 1902 eight colonies of this beetle were distributed to six States. These colonies were in the main put in the charge of entomologists of State experiment stations. In the case of the local colony in the experimental orchard of this Division on the grounds of the Department, the insect wintered well out of doors and started breeding early the present season. This summer some 26 colonies have been distributed in the States of Alabama, Delaware, Georgia, Maryland, North Carolina, New Jersey, New York, Ohio, Oregon, Tennessee, Virginia, and West Virginia. One colony has been dispatched, by request, to the Government entomologist of Cape Colony. Of the distributions of last year, those sent to Georgia have given the best promise. One of these, established in a large orchard of 17,000 peach trees, with a contiguous orchard containing 250,000 trees, both orchards infested with scale, shows especially satisfactory results. An examination of this orchard made by an agent of this office in July, 1903, shows that the ladybird has spread throughout the original orchard of 17,000 trees and now occurs there to the number of 30,000 to 40,000, and as there will be three additional broods this year, the present numbers should be very vastly augmented and some good results should be achieved. A considerable series of new colonies have been distributed from this orchard in various parts of Georgia. The results, therefore, of a single year's experience with this insect are, on the whole, very encouraging. Every effort will be made to quickly distribute this beetle throughout the regions where the San Jose scale occurs. The fact that this introduction is still in the experimental stage should not be forgotten, and too great hopes should not be placed upon it, and the recommendations for the prompt application of sprays and other remedial treatments should not be neglected.

## THE FIG-FERTILIZING INSECT.

The year was a very successful one for the growth of the Smyrna fig. Large crops were raised at Fresno, Cal., and the quality of the figs seems to have been even better than during the previous year. The methods of packing were improved, a number of new orchards of Smyrna fig and caprifig have been started, and the insect has apparently become thoroughly acclimatized both at Fresno and at Niles.

## THE PARASITIC ENEMY OF THE BLACK SCALE.

The important enemy of the black scale, *Scutellista cyanea*, originally imported by the Division from Italy and colonized in Louisiana upon a wax scale, later imported from South Africa and established in the olive and orange groves of California, is proving to be a success in the latter State. The first specimens were received in June, 1900, and were colonized in Santa Clara County. In the summer of 1901 they were not found, but during the past fiscal year they have been shown to have established themselves.

It is, however, in the southern part of the State that this parasite has done its best work, and here it has surpassed the most sanguine expectations both of the Division and of the California authorities. It has been established in every county south of Point Conception, is very plentiful in Los Angeles, Orange, and San Diego counties, and is still being sent out from the office of Mr. Alexander Craw, first deputy commissioner of horticulture at San Francisco. The Los Angeles commissioners distributed over 400 strong colonies at Escondido. At Pasadena they spread naturally in less than a year over a distance of half a mile. In the colonization districts over 90 per cent of the black scale has been destroyed by the parasite, and the latter is still breeding. There is a general feeling of confidence among the orchardists.

This important parasite is evidently of oriental origin, having first been described by Motschulsky from Ceylon, from which place it was evidently accidentally imported into Italy and into South Africa, in both of which localities it has taken a strong foothold upon the larger scale insects.

#### OTHER IMPORTED INSECTS.

The little European moth, *Erastria scitula*, whose larva feeds upon scale insects, and which was imported from Italy through the kindness of Prof. Antonio Berlese during the fiscal year 1902, was established in California under the charge of Mr. Alexander Craw, of the State board of horticulture. The insects were liberated at several places in the State of California, and the latest reports show that the prospects for acclimatization are fair, although no great good has as yet been accomplished.

The European ladybird, *Coccinella septempunctata*, sent from Hungary during the autumn of 1901, has not succeeded in the East. Those sent to California, however, have bred, and some colonies have been liberated. Should it become established this species, it is hoped, will be an important enemy of plant-lice.

The work with the grasshopper fungus reported upon during the previous year has practically been discontinued, the results of the previous work not having been satisfactory, although in a number of localities where the season was characterized by sufficient moisture the disease undoubtedly spread and killed off grasshoppers in considerable numbers. It is, however, in the dry regions that grasshoppers do the greatest damage, and under the conditions prevailing in such regions the fungus does not seem to spread.

#### WORK ON SCALE INSECTS.

The San Jose scale continues to be the prominent fruit pest in this group of insects. The methods of controlling it, however, receive additions and become more effective with each year. The advice issued from this office is embodied in two recently published and revised circulars giving the latest methods of control. A great deal of work has been done in the determination of scale insects for experiment stations and individuals, as in former years. This includes also the determination of considerable material received from foreign sources. On our new island possessions, notably Porto Rico, a great deal of damage from scale insects is being experienced, and this office is writ-



ten to for advice. Similar difficulties are being experienced by American colonists in Cuba. A good deal of information by letter and circular has been sent out to these localities, and steps are under way looking to the introduction of parasitic and predaceous insects to assist in keeping the scale pests in these islands under control. The importance of a complete acquaintance with the scale pests of foreign countries to enable one to detect these enemies on imported fruits and plants and prevent their unwitting introduction, and especially on material coming to this country through the direct agency of this Department, is illustrated by the fact that probably more than 80 per cent of the scale pests of prime importance now established in America are of foreign origin and came on introduced plants.

#### WORK ON THE COTTON BOLL-WEEVIL.

The continued spread of the cotton boll-weevil and the danger threatened the most important industry of the South by the direct prospect that it will soon reach all portions of the cotton belt resulted in the appropriation by Congress of \$20,000 for a continuation and enlargement of the work of the Division with that pest. This work was under the direct charge in Texas of Mr. W. D. Hunter, who was aided by a number of assistants.

The funds at the disposal of the Division enabled it for the first time to conduct experiments with the cultural methods of controlling the pest on a large scale. This was accomplished by entering into contract with two representative large planters in typical situations in Texas. By the terms of these contracts the planters agreed to plant, cultivate, care for, and in every way manage the crop exactly in accordance with the directions of the agent in charge. In this manner the Division was given practically complete charge of 325 acres, but without the trouble and expense of renting the land and working the crop. These experiments were located at Calvert, in the Brazos Valley, the most serious portion of the infested territory at present, and at Victoria, in the extreme southern portion of the State, where the existence of volunteer cotton furnishes the weevils with food very early in the season, thus adding an important feature to the problem that does not occur elsewhere.

At Victoria a field laboratory was fitted up where a thorough study was made of every feature of the life history of the weevil. The matter of parasites and the possibility of controlling the pest by their artificial propagation, which has always appealed strongly to many planters, received especial attention. In pursuance of this feature of the investigation the agent in charge made a trip to Mexico, where the governmental commission that has been created for the study of the weevil problem has especially concerned itself with the propagation of a mite (*Pediculoides ventricosus*) which, at least under certain conditions, has been found to destroy the larvæ of the pest. The agent made a study of the methods pursued in the laboratory of the commission at Cuernavaca, and through the courtesy of Prof. A. L. Herrera, the head of the commission, he was enabled to bring back to Texas a large number of cultures. These parasites were distributed from the laboratory at Victoria. The work is being continued this season, but the indications are decidedly that climatic conditions will

always render unobtainable in Texas whatever useful results may have been obtained in Mexico.

In spite of the fact that the field work of the Division was thrown in the most disastrous season for cotton culture in Texas in twenty-five years, the results have been of the greatest value to cotton producers and the working of the contract system has been satisfactory. The experimental fields have served as demonstrations that cotton can be produced profitably wherever the weevil occurs. Though there seems no probability that the weevil will ever be prevented by either artificial or natural checks from reaching all portions of the cotton belt, the work of the Division has indicated that it is possible to obtain a profitable return in producing the staple by no other means than a few simple expedients in planting and managing the crop. These expedients, consisting of a selection of seed, early planting, and thorough cultivation, enabled the Division to produce at Calvert, without any appreciable extra expense, a crop of 1 bale to 1.5 acres. The average production in the United States is 1 bale to 2.3 acres.

#### INVESTIGATIONS OF INSECTS DAMAGING FORESTS.

With the beginning of the fiscal year, July 1, 1902, a section of the Division was organized for the investigation of insects injurious to forests. Dr. A. D. Hopkins, formerly of West Virginia, was put in charge of this work, and during the year was given three assistants.

The work during the year has been carried on in cooperation with the Bureau of Forestry, and observations and investigations have been made in nearly all of the States and Territories. Rather serious troubles affecting different forests were located in many sections. Some of these are as follows:

The bark-beetle depredations on the silver pine and red fir and lodgepole pine in the Priest River Forest Reserve, Idaho.

An important wood-boring enemy of red fir near the Olympic Forest Reserve, Washington.

Bark-beetle depredations on the Monterey pine and Monterey cypress near Monterey, Cal., causing the death of the pine and transplanted cypress.

A serious trouble affecting the pines of the Rocky Mountain region from Arizona to Idaho, caused by bark beetles, and resulting in the death of a vast amount of timber in the National reserves and on public and private lands.

It was determined that the destruction of many large areas of timber which was supposed to be the result of forest fires was primarily the work of insects, the insects having killed the timber, which then offered favorable conditions for the starting of destructive forest conflagrations.

The destructive pine-bark beetle, which caused such wide devastation in the Virginias in 1891-1892, was located in western North Carolina, and evidence of the destructive work of the same species was found affecting the longleaf pine forests of eastern Texas.

A serious enemy of the wood of the boxed and fire injured longleaf pine was found in Texas, North Carolina, and South Carolina.

The cause of a serious trouble affecting girdled cypress trees where lumbering operations were carried on in the cypress swamps of the Southern States was determined.

The hickory bark-beetle was found to be causing serious depredations in Belle Isle Park, Detroit, Mich., and it was learned that the area infested by this beetle extends from New Haven, Conn., to Wisconsin, and southward to Cincinnati, Ohio.

A great many unrecorded enemies of pine, spruce, fir, cypress, redwood, oak, red fir, hemlock, etc., were found during the year, and much data secured relating to the life histories and habits of these and other injurious and beneficial forest insects.

It is estimated from this preliminary survey that the annual loss from forest insect depredations must be placed at not less than \$100,000,000. This is based on late stumpage values and wholesale prices of the commercial products.

Encouraging progress was made in the attainment of the primary object of the work, namely, the discovery and practical application of methods of preventing losses from the ravages of forest insects. The recommendations made to the Bureau of Forestry and the General Land Office of the Department of the Interior for checking the rapid spread of the pine-destroying beetles of the Black Hills were adopted, as were also recommendations for the control of the serious insect trouble affecting the pine timber on some 200,000 acres of forest and ranch land in northeastern New Mexico, and recommendations to the city of Detroit for the control of the insect affecting the hickory trees in Belle Isle Park. The cost of carrying out these recommendations will not exceed \$3,000, but it means not only the saving of threatened loss of forest property valued at many millions of dollars, but also the prevention of the crippling of great mining and commercial interests in the Black Hills representing millions of dollars.

Three field stations were established, one in the Black Hills, where extensive experiments were carried on with girdled and felled trees, and one at Tryon, N. C., where girdling experiments with pine and chestnut timber near Tryon and the cypress at Borden were carried on and a study of the life histories and habits of the principal forest insects of the Southern States was begun. A field station at Hoquiam, Wash., was also started, and experimental work and investigations of the life histories and habits of the principal enemies of the red fir, Sitka spruce, giant arbor vitae, and Western hemlock were instituted.

#### WORK ON THE CODLING MOTH IN THE NORTHWEST.

The work on the codling moth in the Northwest, referred to in two previous reports, was completed in the autumn of 1902. The special agent in charge completed, during the following winter, a full report on the investigation, which indicates very satisfactory results. The work of the late summer and autumn of 1902 was devoted to a large-scale demonstration of the efficacy of the measures adopted and recommended in Bulletin No. 30, new series, of this office, which was published as the result of the investigations of the calendar year 1901. The large-scale demonstration work showed to the satisfaction of all concerned that the economical control of the codling moth in the Northwest is possible. When it is remembered that this investigation was undertaken at the request of the fruit-growers' associations of Idaho, Washington, and Oregon, on the plea that they had not been able to grow apples successfully even with the careful use of the remedies found efficacious in the East, this result is most satisfactory. It was conclusively shown that



in the infested sections of the far Northwest, if no measures are used, from 85 to 100 per cent of the fruit is injured, but by an intelligent application of the preventive and remedial measures advised by this office many practical tests show that from 85 to 98 per cent of the fruit may be saved. The results of the investigation were briefly summed up in Farmers' Bulletin No. 171, published in June, 1903, and the most hearty indorsements of its value have been received from fruit growers. The full report on the investigation is now being published and will be issued as Bulletin No. 41, of the divisional series.

#### INVESTIGATIONS OF INSECTS INJURIOUS TO TRUCK CROPS.

The investigations of the fiscal year on insects affecting garden vegetables and small fruits were largely in the nature of studies of different species received from correspondents from various portions of the country, and of local species whose habits are little known or which are comparatively new as pests. A special study was made of the insect enemies of the sugar beet, including those which also affect table beets, spinach, and certain related plants useful as forage. A popular preliminary account of the principal sugar-beet depredators was completed, together with many illustrations of the insects in their various stages. This matter is now in the printer's hands, and will soon be made public. Reports received from various special correspondents through the country serve to show that with the increase of the beet-sugar industry, and the consequent larger acreage that will be devoted to growing the sugar beet, the insects which affect this crop will increase in destructiveness, and it is only a matter of time when special investigations will be necessary to counteract their ravages. Among the insects to which special attention has been given are the asparagus miner, numerous forms of blister beetles, the cabbage fly or maggot, several species of crickets, including mole crickets, and stalk borers of various forms, more especially the tobacco-stalk weevil, which has been ascertained to attack potato as well as tobacco, and which may become a pest with the increase of cultivation of potato in the region inhabited by this species. This latter insect has been studied by two agents of this Department, and its approximate life history has been learned. The year having proved unfavorable for experiment with methods of control, this work will be resumed as soon as opportunity offers.

#### WORK ON INSECTS INJURIOUS TO STORED PRODUCTS.

Work begun several years ago on this class of insects has been continued. The Mediterranean flour moth and the cigarette beetle, the former by far the most important pest in flouring mills, the latter a most pernicious enemy of stored tobacco, have continued their ravages, although the remedies which have been discovered for them seem quite efficient if millers, tobacco dealers, and others will employ them. Some of the most common insects injurious to stored cereals and cereal products have continued as injurious as in the past.

During the year considerable complaint has been made of injuries by powder-post beetles (*Lyctus* spp.) and some related insects which injuriously affect wood and similar material when used in manufactures. Much injury to valuable furniture has been incurred.

No better general remedy than bisulphid of carbon has been employed against any of these insects, although hydrocyanic-acid gas has also been used with some success. Farmers' Bulletin No. 45, a short popular treatise on the more important insects affecting stored grain, has reached its tenth edition, and with our constantly increasing knowledge of the subject, will soon require revision. Two hundred and thirty-five thousand copies of this bulletin have been distributed.

#### WORK ON INSECTS AFFECTING ORNAMENTAL PLANTS.

Investigations on insects of this class have been continued, particular attention having been paid to such as are troublesome on roses, and, to a lesser extent, on violets, which have already been very carefully investigated. A number of rose pests, however, are extremely difficult to deal with, and certain of these, some comparatively new and some pests of long standing, have been under more or less continuous observation with a view to ascertaining better methods for their control. Certain forms of flea-beetles and leaf-beetles have been prominent among insect enemies of plants grown for ornament, some of which had not been previously identified with injury. Considerable data have accumulated on the life economy of the fickle midge (*Sciara inconstans* Fitch) which have a practical bearing on means of preventing injuries by it in greenhouses, where it is a general pest nearly throughout our country. A second edition of the bulletin on "Insects injurious to the violet, rose, and other ornamental plants" was necessitated during the year, and this having become exhausted, a third will be issued in the near future.

#### WORK IN SILK CULTURE.

An appropriation to the Department of Agriculture of \$10,000 for investigations in silk culture was made by Congress for the fiscal year 1903. The Secretary of Agriculture naturally placed this investigation in the hands of this Division. Previous work by the Department in the years 1882 to 1891 had already demonstrated the possibility of raising excellent cocoons of the domestic silkworm in all parts of the United States in which the white mulberry tree will grow. Therefore, in the investigations to be undertaken at this time the whole attention of those in charge should naturally be devoted to the main practical aspects of establishing the industry. Undoubtedly the first step to accomplish should be to create a general interest in the subject, to insure the supply of leaves for food for the worms, and to educate as many persons as possible in the care of the worms, so that a crop of cocoons will be assured to any individual or company desiring to go into the reeling business. The Entomologist, during the summer of 1902, visited the silk-growing regions of Europe and investigated the establishments for the selection of pure eggs and the communities in which silk culture has its strongest hold. He also contracted for the purchase of two four-basin reels. Considerable quantities of silkworm eggs of the best races were purchased, and mulberry seeds and cuttings of the best varieties were also contracted for. During the winter and early spring eggs were sent in small quantities to all applicants who were able to assure the Department that they had at hand a proper supply of food for the worms. To those who had no food, mulberry

cuttings were sent. A small crop of cocoons was raised at the Department in the spring of 1903. Nearly all of the persons to whom eggs were sent reported that they had been able to rear the worms and produce the cocoons without great difficulty, and letters were sent informing the raisers that their cocoons would be purchased by the Department at the current European market rates. One of the reels imported from Europe was put in operation at the Department of Agriculture in Washington. Two expert reelers were imported from France, and at the close of the fiscal year reeling operations were about to begin. The establishment of the silk industry in the United States must be a matter of extremely slow accomplishment. Small appropriations by the General Government will assist in the education of an increasing class of silk raisers. The market for the cocoons is the great difficulty at the present time. The small market created by the Department out of this small appropriation is in reality an artificial one. It is necessary, however, to induce people to continue their interest in the subject; it is necessary for the education of a class of silk raisers, and for the present this method will be continued. The second of the four-basin reels was loaned to The Seri-Culture and Manufacturing Company at Tallulah Falls, Ga., where extensive planting of mulberry trees has been carried out, and where experimental work is promised.

#### APICULTURAL INVESTIGATIONS.

The correspondence in relation to apicultural matters has been constantly increasing, and has covered a wider range of subjects, including statistics in relation to the industry, methods of management, new inventions, natural resources of various regions, cultivation of special crops as bee forage, introduction of superior races of bees, etc.

In the autumn of 1902 a trip was made by the apicultural investigator through Nebraska and Colorado for the purpose of investigating certain conditions, especially in Colorado, regarding natural and artificial bee pasturage and the early breeding up of colonies of bees to enable bee keepers to take full advantage of the first crop of alfalfa. The recommendations made to cultivate early pollen-bearing crops, such as Russian hairy vetch, and to employ more prolific, hardy, and strong-winged bees than Italians, such as the Carniolan and Cyprian races and their crosses, have, wherever followed, resulted in a marked increase in the honey yield and in earliness and size of swarms.

At the request of the bureau of farmers' institutes of the State of New York the apicultural investigator was sent to deliver addresses at a series of institutes held in various portions of that State. These were well received, and much interest was manifested throughout the State in improved methods of apiculture.

Visitors at the apiary maintained on the Department grounds are numerous, including many teachers and normal school students, and during the summer months much of the time of the investigator is taken up in this manner, answering personal inquiries and giving practical demonstrations. Were the funds provided for the apiarian work sufficient, this portion might be acceptably done by an assistant, and these numerous interruptions would be avoided, which prevent more important work in the line of investigations.

Much material in the form of specimens of bees and their products, for use in natural history teaching in the public and normal schools,



has been furnished gratis to teachers. This tax upon the time of the investigator has been considerable, and it has been impossible to meet some of the requests.

A number of queens of select breeding have been sent this year, as in the past, to experiment stations engaged in apiarian investigations, and for testing in sections where it seemed advisable to try certain breeds of crosses.

A race of bees little known in this country, the Caucasian, native to the southeastern provinces of Russia, bordering on the Black and Caspian seas, has been under observation. It promises to be a valuable addition to the varieties already bred in this country. The workers are good honey gatherers and most remarkably gentle. The queens are quite prolific. The exact status of the race as regards hardiness has not yet been determined, although in Colorado they have not seemed inferior in wintering qualities to the Italians already there.

Further tests in the matter of methods in queen rearing and the use of small nucleus hives have been continued. The determination of the best and most economical method for rearing queens of the highest type is a subject of prime importance to the industry, and warrants the most thorough investigation that can be given it.

#### EXPERIMENTAL WORK WITH INSECTICIDES.

The value of the standard insecticides, both for biting and sucking insects, including food poisons and substances which kill by contact merely, has been established by many years of experiment; but, nevertheless, by the practical work of the office such standard insecticides receive each year the indorsement of additional satisfactory experience. This applies not only to the control of insect enemies of field and garden crops and fruits, but also to house pests, as illustrated by additional practical work done during the year with the hydrocyanic acid gas treatment of houses described in the last annual report. The experimentation with petroleum oils, referred to in the former report, has been started during the present year in conjunction with the Bureaus of Plant Industry and Chemistry of this Department. This work, it will be recalled, was undertaken in response to special requests from the Society for the Promotion of Agricultural Science and of the Association of Economic Entomologists. The work of this summer has been the making of preliminary field tests with the varying brands of oils coming from different sections of the United States, and also with specially prepared mixtures of oils the constituent elements of which are known, the object being to determine what constituents are beneficial and what are harmful to plants. To facilitate this experimental work in the future a young orchard has been established on the Arlington Farm for insecticide experimental purposes solely, since it has been found necessary to have a body of trees which may be subjected to any experiment whatsoever, irrespective of the probably harmful effects to the treated plants.

This office is in almost daily receipt of announcements of the discovery of insecticides and new methods of insect control. These are duly examined, and, when samples of the insecticide mixtures are sent, very often are submitted to the Chemist for report as to composition. As a rule, these substances prove to be combinations or crude imitations of well-known insecticides, and have no special merit over the latter. It

is often possible to give the devisers of these mixtures advice which will save them from the expense of copyrighting or patenting and exploiting useless substances or methods. A great deal of work of this kind has developed in connection with the boll-weevil. Any of the methods or substances suggested against the latter insect which have any promise whatever of satisfactory results are submitted to the field agent in charge of the work in Texas for practical field tests. As in former years, this office has been in active cooperation with the Bureau of Chemistry in assisting in the examination and analyses of miscellaneous insecticide substances.

#### INVESTIGATIONS OF INSECTS IN THEIR DIRECT RELATION TO THE HEALTH OF MAN.

Work in this important direction has been carried on throughout the year. Nothing further has been published, but careful studies are being made of the habits and geographical distribution of the mosquitoes of the genus *Anopheles*, which have been shown to be the sole conveyers of malaria, and of the mosquito known as *Stegomyia fasciata*, shown to be the conveyer of yellow fever.

#### WORK ON INSECTS INJURIOUS TO SHADE TREES.

Much work on insects of this class has been carried on during the year, and especially during the spring and early summer of 1903. Shade-tree insects were particularly abundant and destructive during this period, and opportunities for remedial work were more frequent than usual. The preparation of an extensive bulletin on the principal shade-tree insects is still under way. It is planned to keep this work on shade-tree insects separate from that of insects which affect forest trees, although to a certain extent they must overlap.

#### UNCLASSIFIED WORK ON INJURIOUS INSECTS.

An extensive investigation of the insects attacking the stems of growing wheat, rye, barley, and oats, not, however, including the Hessian fly, which has been dealt with in other publications of the Division, was carried on during the year, and a final report prepared by a special agent of the Division has been submitted for publication. The insects of the greatest economic value included in this investigation are the joint-worm flies and the wheat-straw worms. An investigation has been begun of the habits of and the best remedies to be used against the gadflies or horseflies of the family *Tabanidae*, which are so annoying to live stock, particularly in portions of the South. Further investigations have been made upon methods of control for certain insect enemies of mushrooms, and a further investigation of the insects affecting the seed of the clover plant has been begun. A report upon the insects affecting the cranberry was prepared by a special agent and is ready for publication. Investigations of the plant-lice which injure grain have been carried on by one of the assistants, and an elaborate treatment of the bill bugs of the genus *Sphenophorus*, injurious to corn and certain grasses and grains, is in course of preparation. In the early part of the fiscal year an investigation was made by one of the scientific assistants of an outbreak of an injurious locust (*Camnula pellucida*) in Idaho, and remedial advice was given which proved of value to the agricultural population of that region.

## WORK ON THE GEOGRAPHICAL DISTRIBUTION OF INJURIOUS INSECTS.

This work, which has been carried on now for a number of years, has been continued during the fiscal year, and the records are now becoming so numerous that they begin to afford an excellent indication of not only the actual range of injurious species, but also indications as to their possible spread.

## TECHNICAL WORK.

A certain amount of the time of the expert entomologists in the employ of the office is devoted to technical work, monographing groups of insects of economic importance, and especially in the way of determination of specimens sent in by the experiment-station entomologists and others who have not access to large collections either of specimens or of books. Several technical bulletins are under way, and these are intended for the use largely of the entomologists of the State agricultural experiment stations.

## BIBLIOGRAPHICAL WORK.

Work on the Bibliography of Economic Entomology is being thoroughly kept up to date. Material is at hand for the publication of a supplementary part No. VIII of the series of bibliographies of economic entomology formerly published (down to January 1, 1900) under a joint resolution of Congress passed in 1882. The Department is informed that this joint resolution no longer holds as authority for printing this bibliography, but it is hoped that it will be continued from the printing fund of the Department.

## CORRESPONDENCE.

With the increasing growth of the Division and increasing appreciation of its value by the agricultural population, its correspondence has naturally greatly increased. During the year more than 8,000 letters have been written in answer to requests for information, and many hundreds of additional requests have been answered by means of circulars.

## PROPOSED WORK FOR THE FISCAL YEAR 1904.

The work for the fiscal year 1904, which at the date of this writing is already well under way, will be carried on in the same directions as the work during the past fiscal year. Most of the investigations described in the foregoing pages are still being carried on. The investigation of the codling moth in the Northwest has been completed. The work against the Mexican cotton boll-weevil in Texas will be carried on during the whole of the fiscal year. An additional field assistant has been appointed, and \$30,000 will be expended in this work on cotton insects. The Department has by contract with the owners established seven experimental stations—one at Victoria, one at San Antonio, one at Austin, one at Calvert, one at Alford, one at Hetty, and one at Wharton. The station at Victoria has been supplied with a well-equipped laboratory. The sum first mentioned will not be entirely devoted to the Mexican cotton boll-weevil, since in the wording of the appropriation clause the cotton boll-worm was included. A special agent has been appointed who will devote the whole fiscal year to the



study of the latter insect, being stationed in Texas for most of the time. The possible spread of the cotton boll-weevil to other cotton States will be carefully watched and considered, and the recent occurrence of the insect in the experimental cotton plantation near New Orleans, La., is an indication of the fact that this investigation must be continued for some time to come, and that a strong effort must be made to prove to the cotton planters of the South that by cultural methods cotton may be grown in spite of the weevil. Investigations made early in the season show that the cotton boll-weevil exists in Cuba, and that it has probably always existed in that island. This point is an important one and renders commercial relations between Cuba and our Gulf ports an element of some danger to the cotton industry.

The work with insects from abroad will be continued, and special efforts will be made to breed and distribute the Chinese ladybird enemy of the San Jose scale.

In the forest insect investigations there will be great activity. The entomologist in charge of this branch of the work, with skilled assistants, will continue the observation and experiment stations mentioned in the preceding pages, and results of great value are to be expected from this work.

In silk culture the reeling work will be carried on at the Department, and as much of the cocoon crop of the calendar year as can be purchased will be reeled into commercial raw silk. More eggs will be imported from Europe and mulberry cuttings as well, and in the spring of 1904 a further distribution of eggs, mulberry cuttings, and seed will be made.

The work in apiculture and in the other branches of research will be continued.

#### **PLANS RECOMMENDED FOR THE FISCAL YEAR ENDING JUNE 30, 1905.**

By the organization of the work in entomology of the Department of Agriculture on the lines of a bureau, as indicated for this year, it is expected to very largely extend and develop the practical work being done in the study of injurious insects. The work of this Division has grown very rapidly during the last few years, but is capable of very much greater development. An organization on the lines of a bureau is already in practical operation, the work of the office being divided into a number of distinct departments, in various instances receiving specific appropriations. The plan of the new organization indicates the subdivision of the work in entomology which it has been decided to make. Many important fields of investigation have remained unworked in the past for lack of funds and expert assistance. If the plans made for the bureau organization meet with approval and receive the sanction of Congress, it is proposed to prosecute work over the whole field of applied entomology in America, as described under the different sections of the classification recommended.

#### **ORGANIZATION OF WORK IN PROPOSED BUREAU OF ENTOMOLOGY.**

The following is the plan of organization of work in the proposed Bureau of Entomology:

Field crop insect investigations:

- (a) Southern section—cotton, tobacco, sugar cane, rice.
- (b) Northern section—cereals and forage plants.

Fruit insect investigations:

(a) Northern section—orchard fruits, deciduous.

(b) Southern section—citrous and other tropical fruits.  
Small fruit and truck crop insect investigations.

Forest and forest product insect investigations.

Insecticide and insecticide machinery investigations:

(a) Section of field operations and experiments.

(b) Section of chemical analyses and tests.

Investigations of insects affecting stored products.

Investigations of insects in relation to disease of man and other animals, and as animal parasites.

Special insect investigations—miscellaneous work:

(a) Section for the investigation and introduction of beneficial insects, and quarantine work.

(b) Section for fungous and other diseases of insects.

(c) Section for special insect investigations—emergency work and unclassified.

Insect laboratory, collections, and experimental garden.

Apicultural investigations.

Sericultural investigations.

Librarian and bibliographer.

#### FIELD CROP INSECT INVESTIGATIONS.

It is proposed to make two sections for this work:

(a) A southern section will have special charge of the insect enemies of cotton, tobacco, sugar cane, and rice, and will include the work now being done under the specific boll-weevil appropriation. The boll-weevil work will be carried on in the same general lines now in progress for 1904. The agents engaged in the cotton boll-weevil work can, however, from time to time, make studies and achieve valuable results with other insect enemies of cotton, and also of the other southern staples mentioned.

(b) A northern section will be devoted to the study of insect enemies of cereals and forage plants, a field of the greatest importance, which heretofore we have been able to cover only in a very fragmentary way by the occasional employment of special field agents to make investigations of particular insect pests of such plants. We hope to employ an expert investigator who shall devote his entire time to this field of inquiry, and to equip him with sufficient assistants and funds to carry out desirable investigations.

#### FRUIT INSECT INVESTIGATIONS.

Two sections are recommended for this field of inquiry:

(a) A northern section relating to the deciduous orchard fruits, which shall include such work as that done in the Northwest on the codling moth, and in addition work on all the other insect enemies of the apple, as well as the other deciduous fruits of America.

(b) A southern section devoted to the study of the insect enemies of citrous and other tropical fruits. This last field, formerly a very important one in the entomological work of the Department, has been practically neglected for several years, with the exception of the investigations made in California by Mr. Marlatt in 1900. It is desired to have a capable expert take charge of a continuous investigation of the insect enemies of all subtropical and tropical fruits, and give such direction and superintendence to work in the new tropical possessions as shall be required of this office. The importance of the subjects warrants the devotion of a sufficient sum to this work to enable prac-

tical field investigations to be made and to permit the publication of the results in the form of bulletins and circulars.

#### SMALL FRUIT AND TRUCK CROP INSECT INVESTIGATIONS.

This field of investigation has been actively covered in the past by this office, but it is possible to very much extend the work by placing it more directly under the control of the present expert in charge, and make it possible, by the establishment of larger experimental grounds, to carry out the investigations systematically and over the entire field. Among the special subjects on which investigations will have to be made in the near future are the insects injuriously affecting the sugar beet, a work that is necessary on account of the rapidly growing importance of this industry.

It is intended during the year 1905 to complete investigations which have already been carried on for a number of years on certain of the most destructive and troublesome insects affecting small fruits, particularly strawberries, blackberries, raspberries, and some similar crops.

#### FOREST AND FOREST PRODUCT INSECT INVESTIGATIONS.

These investigations have already been established as a separate section, working in cooperation with the Bureau of Forestry. In the new organization it is hoped to add to its efficiency by arranging for an additional field assistant and for an office assistant. The work outlined for 1904 will be continued, and special new work for the year will be taken up in the study of the oak and spruce insects with the view of publishing reports toward the close of the year. Any exceptional insect outbreaks in forest areas will be subject to prompt investigation.

#### INSECTICIDE AND INSECTICIDE MACHINERY INVESTIGATIONS.

It is proposed that this section shall cover the entire field of practical experimentation with insecticides and insecticide machinery. The detail of a chemist from the Bureau of Chemistry, to take charge of the analyses and tests, is planned, and it is proposed to provide an expert to work in cooperation with the chemist to carry out the field operations and experiments on growing trees and vegetables. The enormous increase in the employment of insecticides in the last few years calls for very much more extensive investigation on the part of this Department than it has hitherto been possible to give to the subject. The very great use of petroleum oils especially demands a constant supervision of the oil products used for insecticides, some of which are very injurious to plants and others harmless. The demand for a thorough investigation of this field by the Department of Agriculture is voiced by the resolutions recently passed at the meetings of the Society for the Promotion of Agricultural Science and of the Association of Economic Entomologists. The proposed change will bring all the insecticide investigations of the Department under one office and facilitate and give a much more practical bearing to the work than has been heretofore possible.

#### INVESTIGATIONS OF INSECTS AFFECTING STORED PRODUCTS.

A good deal of work has already been done under this head, but it is proposed, by making this a special section, to very much extend



the work and give it a more practical bearing, undertaking experiments to determine in a practical way, in granaries and large warehouses, mills, and other establishments, the value of the means of protecting stored products. It is proposed in this section to include the study of the insect enemies of preserved animal and vegetable food substances, as well as the cereal products, and also materials and fabrics of all sorts.

#### INVESTIGATIONS OF INSECTS IN RELATION TO DISEASES OF MAN AND ANIMALS, AND AS ANIMAL PARASITES.

It is wished to very much extend the considerable work already done in this field. For this purpose it is proposed to establish for it a special section. It will include, in the case of the domestic animals, all of the internal parasitic flies, the external parasitic insects, and the biting flies, such as the horn fly, gadflies, buffalo gnats, etc.; in the case of man and animals the important rôle of insects as conveyers and disseminators of disease. A very capable assistant will be required to take direct charge of this work.

#### SPECIAL INVESTIGATIONS.

Under this head is classified the investigation and introduction of foreign beneficial insects, a subject which has assumed in recent years very great importance. The supervision of quarantine operations will also come in this section, as well as the propagation and distribution of fungous diseases of insects and the general investigation of this important subject. For this work it will be necessary to secure the services of two high-grade experts, one to have charge of insect introductions and quarantine, and the other to be an expert pathologist. Relative to the last, it may be said that this office has been able to carry out its work with insect diseases only through the courtesy and with the material aid of the Bureau of Animal Industry and experts in other offices of this Department. This work is of sufficient importance to demand the appointment of an expert who shall be able to devote all his time to the subject. The artificial use of contagious insect diseases to control insect pests is a field which is constantly demanding investigation, and its importance, perhaps, is much greater than has been hitherto realized.

#### INSECT LABORATORY AND EXPERIMENTAL GARDEN.

A small and very inadequate experimental garden is now attached to the insectary of this Department. It is proposed to secure a larger tract for the establishment of an experimental orchard and garden in connection with the Washington office to facilitate and give a practical feature to the local breeding and insecticide operations. This will necessitate the employment of a gardener and laborer.

#### APICULTURAL INVESTIGATIONS.

In apiculture it is proposed to specially investigate the subject of artificial pasturage, which hitherto has not received the attention it deserves. A series of experiments will be entered upon to determine what crops may be profitably employed to fill the gaps in the honey

yield, or to create artificial pasturage for apiaries, and an effort will be made in this connection to introduce honey plants from abroad. It is proposed to import and test various races or species of bees that are now little or not at all known in this country; for example, the race native to the Caucasus and those found in Dalmatia, Austria, and notably the large bee of the East (*Apis dorsata*), to be obtained from the Philippine Islands. The breeding of crosses will be continued, and the collection of statistics is proposed. Further, it is especially desired to undertake experimental and remedial work with the diseases of bees; and particularly with an obscure disease which has been playing havoc with certain apiaries in the State of New York.

#### SERICULTURAL INVESTIGATIONS.

It is desired to make this a special section of the entomological work of the Department. To carry out the investigations increased appropriations are desired. For the year 1905 it is the intention to follow up the work outlined for the year 1904; to establish and equip experimental stations in the South; to enter into cooperative work in silk raising with some of the agricultural experiment stations which have expressed the wish to assist us in the investigation of silk culture; to increase the size of the reeling plant in Washington, so that more cocoons can be reeled, and so that instruction can be given.





## REPORT OF THE DIRECTOR OF THE OFFICE OF EXPERIMENT STATIONS.

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U. S. DEPARTMENT OF AGRICULTURE,  
OFFICE OF EXPERIMENT STATIONS,  
*Washington, D. C., September 21, 1903.*

SIR: I have the honor to present herewith the report of the Office of Experiment Stations for the fiscal year ended June 30, 1903.

Respectfully,

A. C. TRUE,  
*Director.*

Hon. JAMES WILSON, *Secretary.*

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### WORK OF THE YEAR, WITH RECOMMENDATIONS.

#### DEVELOPMENT OF WORK OF OFFICE OF EXPERIMENT STATIONS.

The business of the Office of Experiment Stations has continued to grow during the past year, and several new features have been especially developed. The work in relation to the farmers' institutes has been put on a permanent basis and systematic efforts are now being made to bring the Department into close relations with the State organizations through which the institutes are managed. Attendance at the institutes now aggregates about 1,000,000 persons. It is believed that they may be made a very effective means for the more thorough dissemination of the information gathered by this Department and the experiment stations. There has been increased interest in the work of the Office relating to agricultural education. During the past year especial emphasis has been placed on encouraging the establishment of secondary and elementary courses in agriculture. The agricultural experiment stations in Hawaii and Porto Rico have made good progress in the institution of systematic investigations, and gratifying recognition of the value of the work of these stations has been made by the insular governments, as indicated by liberal appropriations for their equipment and the extension of their work. In Alaska a beginning has been made of investigations in the Copper River Valley, where there is a large region suited to agriculture, and it is hoped that means may be provided for the establishment of a permanent station in this region. In the irrigation investigations greater attention has been given to studies of the duty of water in different regions and for various crops, with a view to determining how the water supply of the irrigated region may be most economically and efficiently used. Attention has also been given to the legal and economic problems involved in the use of interstate streams for irrigation. Special efforts are being made to

enlarge the work of the Office in the investigation of problems relating to farm machinery and the use of different kinds of power for agricultural purposes. It is believed that the investigations in this line might be extended with great advantage to the agriculture of the country. Their results would also aid the agricultural colleges to put on an efficient basis the courses in farm mechanics, for which there is now a great demand and which some of these institutions are already establishing. A new feature of the nutrition investigations has been a large cooperative investigation in the Government Hospital for the Insane in the District of Columbia, which has resulted in showing that, while the diet given the patients and employees in that institution was ample as regards its nutritive value, greater variety might be afforded, and at the same time much waste might be avoided, by stricter supervision of the food supply as related to its nutritive value. Important investigations on the digestibility of cereals, fruits, and meat were completed, and reports on a large series of metabolism experiments with the respiration calorimeter were prepared for publication. In cooperation with the Association of American Agricultural Colleges and Experiment Stations the Office has undertaken a large amount of work in connection with an exhibit of the progress of agricultural education and research at the St. Louis Exposition.

## AGRICULTURAL EXPERIMENT STATIONS IN THE UNITED STATES.

### PROGRESS OF THE STATIONS.

The success of the agricultural experiment stations in leading the way to the improvement of agricultural practice on a grand scale is having as one of its effects a closer union between the stations and the farmers in enterprises directly affecting farm methods. This is leading to demands that the stations shall conduct at least a portion of their investigations in a larger and broader way in order that the results of scientific investigations, whether in the field or the laboratory, may be more definitely and thoroughly applied in practice under the conditions actually encountered on the farm. A good example of this may be found in the recent cooperative experiments conducted by the Iowa station at Odebolt, Iowa. The proprietor of a large farm at that place desired to know whether or not the by-products of corn, flaxseed, or cotton seed, or some of the prepared stock feeds when fed in conjunction with corn, would give better results than corn alone. He furnished 220 cattle and the corn and roughage necessary for conducting a feeding experiment. The Iowa station furnished the by-products and stock feeds and conducted the experiment. The results were eagerly watched for by stockmen all over the State. The first tests gave results indicating that the addition of so-called condimental stock feeds to a corn and wheat-straw ration gave much lower returns per steer than corn and wheat straw alone. The experiments will be continued. The farmer will learn to his own great profit the most economical rations for feeding large lots of cattle; the station will publish the results for the benefit of all feeders. Thus are both farmer and station benefited by cooperation.

One of the results of the thorough work of the Illinois station on the breeding of corn has been the formation of the Illinois Seed Corn Breeders' Association, a chartered organization, with a limited mem-

bership of reputable and well-known corn growers, pledged to select and grow their seed corn according to definite rules formulated by the station and to sell only their own crop. The success of this enterprise has been phenomenal. All of the available supply of the improved seed is rapidly disposed of to farmers, and much of it is engaged in advance. The work of this station on corn is proving to be far-reaching in its results, not only in improving the general quality of seed corn, but in inducing practical men to undertake the breeding for special qualities—for protein, for oil, or for starch—which the station has demonstrated to be entirely feasible. As a recognition of the value of such work and with an intelligent appreciation of the fact that investigations conducted on a large scale are necessarily costly, the farmers' organizations of Illinois have rallied to the support of that station, securing last year State appropriations aggregating \$46,000 for special investigations, and this year nearly twice that amount, \$85,000.

The Minnesota station has been extending its investigations in the breeding of improved varieties of wheat and other kinds of grain, making thousands of crosses, and wherever promising new varieties are found testing them in a large way both at the station and on hundreds of farms throughout the State. Such work is relatively expensive and can only be done by the aid of State funds to supplement those given the station by the National Government.

The investigations of the Wisconsin and New York State stations in dairying, which have produced such far-reaching practical results, have necessarily involved the expenditure of thousands of dollars, though the total amount thus used is insignificant compared with the increased wealth which has accrued to individuals and the nation as the outcome of this work.

The successful extension of the work of a few stations, as shown in the examples cited, naturally raises the question of the desirability of granting the stations generally larger funds for the prosecution of their investigations. In accordance with the intent of the Hatch Act, the States have done much toward supplying the stations with suitable buildings and other facilities. In a number of States appropriations are also made for current expenses. During the past year the following notable additions to the resources of the stations have been made:

In a number of States appropriations have been made for special investigations and for the establishment of substations. The California legislature has appropriated \$5,000 for the establishment of a poultry experiment station at Petaluma and \$3,000 for viticultural investigations; the Illinois legislature, \$25,000 for live-stock investigations, \$25,000 for soil investigations, \$10,000 for corn investigations, \$10,000 for horticultural investigations, and \$15,000 for dairy investigations, a total of \$85,000 per annum; the Kansas legislature, \$32,550 for the equipment and maintenance of Fort Hays substation, including \$1,000 for irrigation investigations in cooperation with this Department; the Nebraska legislature, \$15,000 for the establishment and maintenance for two years of a substation for investigating problems of the semi-arid region in the western part of the State; the North Dakota legislature, \$5,000 for a substation to be located at Edgeley; the Tennessee general assembly, \$600 for cooperative investigations with field crops and fertilizers on the type soils of the State; the Utah legislature, \$12,500 for the establishment and maintenance for two years of five experiment farms in different sections of the State to test the possi-



bilities of nonirrigable lands; the Wisconsin legislature, \$1,500 annually for two years for tobacco investigations and \$2,500 annually for two years for cranberry investigations.

There are also a number of instances in which State appropriations to supplement the Hatch fund have been made, notably in California, \$5,000 for publishing delayed bulletins and \$6,000 annually for two years for university printing, including station publications; in Hawaii, \$16,800 in aid of the Federal experiment station for two years; in Missouri, a special appropriation of \$10,000 for the station and large college appropriations in which the station will share; in Tennessee, \$10,000 for the purchase of additional farm lands; in Utah, \$11,650 for station equipment and maintenance, and in Wisconsin \$10,000 for the purchase of live stock and a like sum for additional farm lands.

During the fiscal year ended June 30, 1902, fifty stations shared in the benefits of the Hatch fund. Twenty-three of these were given additional State aid and twenty-seven did not receive State aid. Of the State appropriations for Federal stations, six did not exceed \$1,000, and only eight equaled or exceeded the Hatch appropriation of \$15,000. Several of the State appropriations were for the support of substations and were not shared by the Federal stations. The total State appropriations for stations and substations were but little more than 51 per cent of the Hatch fund.

The meagerness of the funds available for investigation in the twenty-seven unaided Federal stations is shown by the following figures from the statistical reports on the expenditures of the Hatch fund in those stations: Their total receipts from the Hatch fund were \$405,000. Their expenditures for administration and permanent improvements (salaries, labor, traveling expenses, postage, stationery, libraries, and fixtures) amounted to \$313,086.38, or an average of \$11,595 for each station. The average amount expended for publications was \$760. This leaves an average for each station of only \$2,645 for the general expenses of investigations (chemical supplies, fertilizers, feeding stuffs, tools, implements, and machinery, scientific apparatus, live stock, seeds, plants, sundry supplies, freight and express, heat, light, water, and contingent expenses). The stations are organized in a number of divisions representing the different branches of agriculture and related sciences; the average number of investigators employed by each station is ten. Dividing the sum available for general expenses by the number of investigators we have an average of \$264.50 for each investigator. The whole amount (\$2,645) would hardly pay the expenses of a good-sized feeding experiment or a field experiment involving tests in several different localities. How inadequate, then, does such a sum appear to be when divided among ten investigators. Under these conditions it is not strange that so many problems of the farm remain unsolved; it is wonderful that so much has been accomplished by our smaller stations.

These figures show conclusively that if our stations are to be continued on the broad basis on which they are at present organized they must generally be supplied with larger funds for the general expenses of investigations in order to conduct their work in a thorough and satisfactory manner. The States can and undoubtedly will supplement the National funds more fully as time goes on, but since the results obtained by the stations are in many cases of general value to the agriculture of the United States it seems proper that they should receive additional financial aid from the National Government now that they

have demonstrated their ability to stimulate and increase the agricultural production of the country. This supplemental aid should, of course, be granted under conditions which will insure its exclusive application to meet the expenses of agricultural investigations and which will stimulate the States to increase their contributions to the support of the stations.

In this connection it is well to consider that with the increase of agricultural operations in this country the States generally will be called upon to establish a much larger number of stations or substations than at present exist. The areas over which many of the stations in this country are required to extend their jurisdiction are so large that they can not meet the demands for investigations adapted to the various conditions of soil, climate, and rational agricultural practice in their several States. In no section of the United States are there as many stations in proportion to land area as in France or Germany. In our smallest States along the Atlantic coast we have one station for 24,000 square miles; France and Germany have eight times as many. The South Central States with their 10 stations are 40 per cent larger than all of France and Germany with their 151 stations, and Texas alone, with one Federal station, is 27 per cent larger than either of these countries. The ratio of stations to area in France and Germany is 96 to 1 as compared with Texas, 28 to 1 as compared with Minnesota and the Dakotas, and 39 to 1 as compared with the Pacific States.

Under present conditions the stations as a rule are not able to grapple with the larger problems of our agriculture in a sufficiently broad and thorough manner to give the surest expectation of success. The stations, generally speaking, are now in a position to utilize larger funds effectively since questions relating to organization and methods and lines of work have been largely solved.

In another direction the importance of the work of the experiment stations is receiving increased recognition. The amount of data published by the stations on many agricultural subjects is now very large, and the recent attempts which have been made to reduce this material to organized form, in order that it may be utilized for purposes of agricultural education, have shown that the stations are doing a great work in supplying the materials out of which a definite science of agriculture is being constructed, and on which courses of instruction in agriculture of different grades can be successfully based. Already it is apparent that this educational function of the stations is of fundamental importance, and that on the thoroughness and success of the station investigations will depend very largely the successful formulation and maintenance of a thorough system of agricultural education suited to the requirements of the vast masses of our agricultural population. With the discovery of the efficiency of the stations in this line the first impulse has been to insist that the station workers shall themselves undertake the organization of our system of agricultural education and deal directly with the instruction of our agricultural people in colleges, schools, and farmers' institutes. But the attempts to draw off our station workers into these lines of endeavor, in so far as they have proved successful, have operated to diminish the output of new material by the stations, and so delayed the construction of the most efficient courses of instruction in agriculture. Happily forces are already at work to stop this wasteful dissipation of energy, and in spite of some ebb and flow in their devotion to original research

the stations are giving their officers better facilities for advanced work, and expecting more of them along this line. There is, however, still need that the managers of the stations shall insist more rigidly and universally that station officers make the investigation of agricultural problems their chief business, and shall protect them from being drawn away into other lines of work. As most of our institutions are organized, the station is a university department standing at the head of the institution. Its requirements are therefore entitled to first consideration, and the lower grades of work should be duly subordinated. The successful agricultural investigator should not be expected to teach elementary classes or go on prolonged campaigns as a farmers' institute lecturer. Short courses of lectures or demonstrations to advanced students or an occasional address at an institute are profitable, both for the investigator and his hearers, but nothing should be allowed to interfere with the orderly and efficient progress of the station investigations.

With the increased interest in agricultural education and farmers' institutes it is more than ever necessary to urge the establishment and maintenance of right relations between the agencies for agricultural education and the experiment stations. Without doubt the agricultural colleges, of which the stations are departments, should take a more active interest in the development of agricultural education, including both the schools and the farmers' institutes. But this interest should be manifested in securing the proper organization of agricultural education, which will involve specialization of work and function, so that experiment stations, college courses, secondary schools, nature-study courses, farmers' institutes, etc., shall be clearly differentiated and funds and officers provided to conduct each without interference with the other. As regards the Hatch fund, it should be clearly understood that this is not granted for the maintenance of farmers' institutes or any other form of agricultural instruction. The States should provide the funds for all educational purposes connected with agriculture not provided for by the Morrill fund. In some quarters apparently misconception has arisen regarding the policy of this Office on educational matters. The Office is taking enlarged interest in agricultural education, including the farmers' institutes, but with no intention of insisting less strongly on the necessity of thorough original investigations by the experiment stations. It is, in our judgment, a most foolish policy to weaken the work of original research in agriculture on the pretext of giving more efficient aid to agricultural education. The highest interests of agricultural education, as well as the practical interests of our agriculture, demand that the stations shall increase rather than diminish the thoroughness and efficiency of their efforts to solve agricultural problems. For this reason the Office is planning all its work with reference to aiding the stations as far as it can in developing and strengthening their original researches.

#### SUPERVISION OF EXPENDITURES.

The seventh annual examination of the work and expenditures of the agricultural experiment stations which receive the National funds appropriated under the act of Congress of March 2, 1887 (Hatch Act), with special reference to the fiscal year ended June 30, 1902, was made during the past year in accordance with the authority conferred upon



the Secretary of Agriculture by Congress, and a report of this investigation was prepared for transmission to Congress, as required by law. This report was published as Senate Document No. 104, Fifty-seventh Congress, second session.

As heretofore, the report was based upon three sources of information, viz, the annual financial statements of the stations, rendered on the schedules prescribed by the Secretary of Agriculture in accordance with the act of Congress; the printed reports and bulletins of the stations, and the reports of personal examinations of the work and expenditures of the stations made during the year by the Director, assistant director, and one other expert officer of the Office of Experiment Stations.

The following statements are taken from the report:

#### STATISTICS OF THE STATIONS.

Agricultural experiment stations are now in operation under the act of Congress of March 2, 1887, in all the States and Territories and in Alaska, Hawaii, and Porto Rico. In Connecticut, New Jersey, New York, Hawaii, Missouri, Alabama, and Louisiana separate stations are maintained wholly or in part by State funds. A number of substations are also maintained in different States. Excluding the substations, the total number of stations in the United States is 60. Of these 55 receive appropriations provided for by act of Congress.

The total income of the stations during 1902 was \$1,328,847.37, of which \$720,000 was received from the National Government, the remainder, \$608,847.37, coming from the following sources: State governments, \$369,771.12; individuals and communities, \$2,301.38; fees for analyses of fertilizers, \$80,942.36; sales of farm products, \$105,644.60; miscellaneous, \$50,187.91. In addition to this the Office of Experiment Stations had an appropriation of \$139,000 for the past fiscal year, including \$12,000 for the Alaska experiment stations, \$12,000 for the Hawaiian investigations, \$12,000 for the Porto Rico investigations, \$20,000 for nutrition investigations, and \$50,000 for irrigation investigations. The value of additions to the equipment of the stations in 1902 is estimated as follows: Buildings, \$176,113.78; libraries, \$11,941.98; apparatus, \$19,727.94; farm implements, \$14,982.56; live stock, \$20,554.27; miscellaneous, \$19,509.09; total, \$262,829.62.

The stations employ 710 persons in the work of administration and inquiry. The number of officers engaged in the different lines of work is as follows: Directors, 53; assistant and vice directors, 18; special agents in charge, 3; chemists, 151; agriculturists, 54; agronomists, 7; animal husbandmen, 25; horticulturists, 73; farm foremen, 25; dairymen, 34; botanists, 50; entomologists, 50; zoologists, 6; veterinarians, 27; meteorologists, 12; biologists, 8; physicists, 5; geologists, 4; mycologists and bacteriologists, 20; irrigation engineers, 9; in charge of substations, 14; secretaries and treasurers, 25; librarians, 10; clerks and stenographers, 41. There are also 103 persons classified under the head of "miscellaneous," including superintendents of gardens, grounds, and buildings; apiarists; vegetable, plant, and animal pathologists; herds-men, poultrymen, etc. Three hundred and sixty-four station officers do more or less teaching in the colleges with which the stations are connected.

The activity and success of the stations in bringing the results of their work before the public continue unabated. During the year they published 373 annual reports and bulletins—many more than are required by the Hatch Act. These were supplied to over half a million addresses on the regular mailing lists. A larger number of stations than formerly supplemented their regular publications with more or less frequent issues of press bulletins, and most of the stations report a large and constantly increasing correspondence with farmers on a wide variety of topics.

During the year a number of new institutions for investigations in agriculture have been established. The Virginia State board of agriculture has established at Saxe, Charlotte County, an experimental farm for the purpose of making fertilizer tests in accordance with the State fertilizer law. The Mississippi legislature has appropriated \$13,000 for a new substation, which has been located at McNeill on a 2,000-acre tract of donated land. A new Texas substation, for which the State legislature appropriated \$10,000, has been located at Troupe, in Smith County. The Kansas experiment station has finally come into possession of 3,500 acres of the Fort Hays Reservation and has established there a substation supported by State funds. The

Agricultural Epitomist Experiment Station has been recently established at Spencer, Ind., on a farm of 500 acres owned and conducted by the company which publishes the Agricultural Epitomist.

#### NUMEROUS CHANGES IN THE PERSONNEL OF THE STATIONS.

During the past year there have been an unusually large number of changes in the personnel of the station staffs. A number of station officers have been called to positions in various branches of this Department; others have been attracted by financial and other considerations to engage in commercial and journalistic enterprises under private management. The expansion of the work of the agricultural colleges, schools, and experiment stations has caused the creation of a considerable number of new positions. There has also been a larger competition among our agricultural institutions to secure the services of thoroughly trained and experienced men, and this has led to a quite general raising of the salaries of agricultural experts. All these causes operating together have led to a widespread shifting of men from one place to another and in the aggregate have seriously affected the quantity and quality of the recent work of our stations. Most agricultural problems require a large amount of serious and continuous work for their solution. The repetition of experiments on a consistent plan during a series of years is often a factor essential to their success.

An intimate acquaintance with local conditions of climate, soil, and plant and animal life is in many cases very important to the agricultural investigator. For these and other reasons station officers should have a permanent tenure of office. In the past it has been necessary to plead for this in order that station officers might be protected against removal for political or other illogical reasons. Happily these irregularities and inconsistencies of station management have now largely been eliminated. But the necessity of securing greater permanence in the personnel of the stations still remains, and this is a matter to which boards of management would do well to give serious attention. In the case of experienced workers who have made a successful record as investigators it is worth while considering the advisability of contracts for periods of, say, three to five years.

In engaging station officers there should also be more definite agreements regarding the nature and extent of the work to be undertaken, the opportunities for investigation which will be afforded, and the relation of teaching and other duties to the work of research. It can not be expected that the services of first-class investigators can be secured and retained unless they are assured that there will be real opportunities for good work in their line and sufficient funds for the general expenses necessarily attending efficient research. There still needs to be more thorough study of the requirements of research work in agriculture on the part of those charged with the general management of our experiment stations, in order that the grade of their enterprises may be steadily raised and that their work may most efficiently contribute to the success of our vast agricultural interests.

#### OVERWORKED CONDITION OF STATION OFFICERS.

As the representatives of this Office have visited the experiment stations in different parts of the country during the past year, they have been deeply impressed with the fact that many of our most successful station officers are being overworked. This is chiefly due to the great variety of services which they are called upon to perform. Teaching, lecturing at farmers' institutes and elsewhere, writing books, compiling bulletins and newspaper articles, corresponding with a large number of persons on a great variety of subjects, attending meetings of associations, agricultural fairs, etc., absorb a large amount of time and energy. And when to these things is added the earnest pursuit of new knowledge by night and by day, with perhaps little vacation from year to year, the worker either breaks down prematurely or else, as most frequently happens, the character of his work increasingly approximates the level of mediocrity.

A part of the fault of this unfortunate state of things is undoubtedly to be laid to the charge of the workers themselves. Success in one line often tempts men to broaden their operations to cover lines of effort for which they have no special fitness. An itching for popular applause or the fascinations of administrative functions seduce many investigators to neglect their laboratories for the office and the lecture platform.

The notion that a man is great according to the multiplicity of his works rather than to their permanent value is widespread among us. The vast and complicated operations of the leaders of our industrial system are too often taken as a model to be followed as far as possible in our educational and scientific institutions.

To have one's ear constantly to the telephone, to dictate rapidly to a stenographer, to be ever on the move in a limited express train—the American scientist seems often to think he is deprived of his rightful privileges if he can not do all these things. To sit down quietly, to plan a thorough investigation of a particular problem, and to pursue the details of that plan month after month until the solution is gained is one of the most difficult things to do amid the feverish activity of our modern world.

Many men attribute their failure to achieve success as investigators to their environment when the trouble is really in themselves. Complaints about lack of time and funds and opportunities count for very little when they come from men who are evidently spreading the scope of their operations beyond a reasonable limit and who can not produce well-conceived and carefully thought out plans of research. When a station worker tells us in one breath that he can not investigate because he is overloaded with teaching and in the next informs us that his spare time is occupied in the private management of a large farm, or that he is on the lookout for an opening as college president, we can hardly be expected to sympathize with him if he proves a failure as an investigator.

But, on the other hand, the failure of our station officers to reach their highest efficiency as investigators must, in very many cases, be attributed to the conditions under which they are compelled to work. Without doubt many advantages have accrued to our stations from their union with colleges, but many evils have also befallen them because of the crude condition of these educational institutions.

Too many of our agricultural colleges are even yet in the high-school stage, and the number of class-room periods required of members of their faculties is reckoned on that basis. This condition is aggravated by the recent popularity of these colleges, which has swelled the number of their students beyond their capacity to accommodate, and has thus materially increased the labors of the teaching staff. When to this is added the success of our experiment stations so that their correspondence and outside calls for their assistance have swelled to vast proportions, and the success of the farmers' institutes and other forms of college extension work among farmers, the demands upon many of our station workers have exceeded their powers of physical and mental endurance.

The splendid liberality of many of our State legislatures toward the agricultural colleges in providing for their equipment with buildings and apparatus is most praiseworthy, but even this has, at least temporarily, laid heavier and most distracting burdens on our station workers. Enlarged material equipment and increased numbers of students are, without doubt, putting heavy burdens upon college presidents and boards of management, who must care for these things and provide teachers for the daily routine of college courses. Their task is a most difficult one and the public needs to have a more intelligent appreciation of its requirements. But it is nevertheless very important that the just claims of the experiment stations to the best services of able investigators should be duly considered and adequately met.

The value of experiment stations as agencies for the improvement of farm practice and as instruments for the enlargement of the science of agriculture, on which the courses in our agricultural schools and colleges are based, is becoming more apparent with each passing year. Theoretically, this is more generally acknowledged by the managers of our colleges; but many of them are still urging what they consider valid reasons for refusing to transmute this theory into practice. And our observations of the past year convince us that there has never been a time when it was more necessary to plead on the behalf of our successful station workers that they be relieved from onerous and multifold routine duties, in order that their vigor may be long maintained and their best energies be given to experimental research on behalf of agriculture.

More attention should, in our judgment, be given by the managers of our stations to the hours of labor required of, and the seasons of rest afforded and even enforced upon, our successful station workers. After proper training for research has been acquired, the length of the period during which sustained efforts of the highest order are successfully made is a most important factor in the success of our agricultural investigators. What a waste and loss when the man whose early career gives promise of much fruit of research breaks down in middle life and either dies or lives on in the shadows of mediocrity. Good investigators are exceedingly rare, and it is really the duty of boards of control and college presidents to seek out such men and to guard them carefully against overwork and dissipation of energy.

We plead, therefore, for a broader and deeper study of the human side of our institutions of agricultural research, in order that there may be a richer and more continuous return for the great outlay which our people are making in the hope of benefiting agriculture, and that there may be a greater enriching of the intellectual side of our agricultural colleges, the permanent success of which depends after all very largely on the work of their research departments.



## COOPERATION OF THE STATIONS WITH THE DEPARTMENT.

During the past year there has been an increase in the amount of cooperation between the different Bureaus and Divisions of the Department and the State experiment stations, and much of this work has been put on a more permanent basis. The amount of such work might undoubtedly be still further increased with beneficial results if the resources of the stations would permit. Since it is the policy of the Department to manage these cooperative enterprises so as to preserve the autonomy of the stations and recognize them as the public agencies directly dealing with the agricultural problems of their respective States, it is unfortunate that in many cases the stations are as yet unable to devote themselves to such work as largely as they would like through lack of funds. An increase in the funds granted the stations would enable them to adjust their relations to the Department in these matters on a more satisfactory and efficient basis.

*Summary of cooperative enterprises between the Department and the colleges and stations.*

Station.	Bureau, Office, or Division.	Line of work.
Alabama .....	Plant Industry .....	Tests of novelties introduced by seed trade.
Arizona .....	Plant Industry .....	Investigations on the improvement of desert ranges.
California .....	Chemistry .....	Investigation of the gluten content of wheat.
	Chemistry .....	Sugar-beet investigations.
	Chemistry .....	Influence of environment on sugar content of muskmelons.
	Chemistry .....	Available plant food in soils.
	Experiment Stations .....	Irrigation investigations.
	Experiment Stations .....	Nutrition investigations.
Colorado .....	Animal Industry .....	Investigation of the conditions and limitations incident to extension of dairy industry in short-grass country between Mississippi River and Rocky Mountains.
	Chemistry .....	Investigation of the gluten content of wheat.
	Chemistry .....	Sugar-beet investigations.
	Chemistry .....	Influence of environment on sugar content of muskmelons.
	Chemistry .....	Available plant food in soils.
Connecticut (State) ...	Plant Industry .....	Tests of novelties introduced by seed trade
	Plant Industry .....	Studies of alfalfa plant.
	Forestry .....	Tree-planting experiments.
	Soils .....	Tobacco investigations.
Connecticut (Storrs) ...	Experiment Stations .....	Nutrition investigations.
Delaware .....	Plant Industry .....	Cover crops for orchards.
Florida .....	Plant Industry .....	San Jose scale and Asiatic ladybird.
	Chemistry .....	Tests of novelties introduced by seed trade.
	Entomology .....	Available plant food in soils.
Georgia .....	Entomology .....	San Jose scale and Asiatic ladybird.
	Entomology .....	San Jose scale and Asiatic ladybird.
	Experiment Stations .....	Nutrition investigations.
Idaho .....	Plant Industry .....	Tests of novelties introduced by seed trade.
Illinois .....	Plant Industry .....	Tests of novelties introduced by seed trade.
	Chemistry .....	Available plant food in soils.
	Entomology .....	Wheat insects.
	Soils .....	Soil survey.
Indiana .....	Plant Industry .....	Tests of novelties introduced by seed trade.
	Chemistry .....	Investigation of the gluten content of wheat.
	Chemistry .....	Sugar-beet investigations.
	Chemistry .....	Influence of environment on sugar content of muskmelons.
Iowa .....	Animal Industry .....	Investigations in sheep breeding to produce type better suited to range conditions.
	Plant Industry .....	Tests of novelties introduced by seed trade.
	Plant Industry .....	Cereal investigations.
	Chemistry .....	Sugar-beet investigations.
	Chemistry .....	Available plant food in soils.
Kansas .....	Animal Industry .....	Investigation of the conditions and limitations incident to extension of dairy industry in short-grass country between Mississippi River and Rocky Mountains.
	Plant Industry .....	Tests of novelties introduced by seed trade.
	Plant Industry .....	Cereal investigations.
	Chemistry .....	Available plant food in soils.
	Experiment Stations .....	Irrigation investigations.

*Summary of cooperative enterprises between the Department and the colleges and stations—  
Continued.*

Station.	Bureau, Office, or Division.	Line of work.
Kentucky .....	Plant Industry .....	Influence of origin of red-clover seed on yield of crop.
	Plant Industry .....	Rotation of crops, farm management, including tests of varieties introduced by seed trade, methods of establishing and maintaining permanent pastures.
	Chemistry .....	Investigation of the gluten content of wheat.
	Chemistry .....	Sugar-beet investigations.
	Chemistry .....	Influence of environment on the sugar content of muskmelons.
Louisiana .....	Chemistry .....	Available plant food in soils.
	Entomology .....	San Jose scale and Asiatic ladybird.
	Entomology .....	Horseflies, Mexican cotton boll-weevil, and mosquitoes.
Maine .....	Soils .....	Soil survey.
	Plant Industry .....	Influence of origin of red-clover seed on yield of crop.
Maryland .....	Plant Industry .....	Variety tests of vegetables.
	Chemistry .....	Available plant food in soils.
	Experiment Stations .....	Nutrition investigations.
	Plant Industry .....	Cereal investigations and varietal test of sweet potatoes.
Massachusetts .....	Plant Industry .....	Influence of origin of red-clover seed on yield of crop.
	Chemistry .....	Investigation of the gluten content of wheat.
	Chemistry .....	Influence of environment on sugar content of muskmelons.
Michigan .....	Soils .....	Chemical study of soils and soil survey.
Minnesota .....	Chemistry .....	Available plant food in soils.
	Plant Industry .....	Influence of origin of red-clover seed on yield of crop.
	Plant Industry .....	Growing of sugar-beet seed.
	Chemistry .....	Investigation of the gluten content of wheat.
	Chemistry .....	Sugar-beet investigations.
Mississippi .....	Chemistry .....	Available plant food in soils.
	Plant Industry .....	Cereal investigations, forage and other crops.
	Chemistry .....	Available plant food in soils.
Missouri .....	Entomology .....	Mosquitoes.
	Statistics .....	Statistics relating to cost of growing field crops and to farm management.
Missouri State Fruit .....	Experiment Stations .....	Nutrition investigations.
Montana .....	Soils .....	Soil survey.
	Animal Industry .....	Experiments in steer feeding.
Nebraska .....	Plant Industry .....	Studies of alfalfa plant in relation to agriculture of Missouri.
	Plant Industry .....	Formation and management of meadows and pastures.
Nevada .....	Plant Industry .....	Influence of origin of red-clover seed on yield of crop.
	Chemistry .....	Available plant food in soils.
	Chemistry .....	Investigation of the gluten content of wheat.
New Hampshire .....	Experiment Stations .....	Irrigation investigations.
	Experiment Stations .....	Bitter rot of apples.
New Jersey .....	Experiment Stations .....	Irrigation investigations.
	Plant Industry .....	Tests of novelties introduced by seed trade.
New Mexico .....	Plant Industry .....	Influence of origin of red-clover seed on yield of crop.
	Entomology .....	Cranberry insects.
New York (State) .....	Entomology .....	San Jose scale and Asiatic ladybird.
	Experiment Stations .....	Irrigation investigations.
New York (Cornell) .....	Chemistry .....	Available plant food in soils.
	Chemistry .....	Sugar-beet investigations.
North Carolina .....	Entomology .....	San Jose scale and Asiatic ladybird.
	Entomology .....	Soil survey.
North Dakota .....	Soils .....	Soil survey.
	Plant Industry .....	Influence of origin of red-clover seed on yield of crop.
North Dakota .....	Plant Industry .....	Cereal investigations and forage and other crops.
	Plant Industry .....	Work on cereals to improve wheat industry.
North Dakota .....	Plant Industry .....	Introduction of improved varieties of flax.
	Chemistry .....	Available plant food in soils.
North Dakota .....	Soils .....	Soil survey.
	Soils .....	Soil survey.

*Summary of cooperative enterprises between the Department and the colleges and stations—*  
Continued.

Station.	Bureau, Office, or Division.	Line of work.
Ohio.....	Plant Industry .....	Influence of origin of red-clover seed on yield of crop.
	Chemistry .....	Available plant food in soils.
	Entomology .....	San Jose scale and Asiatic ladybird.
Oregon .....	Plant Industry .....	Influence of origin of red-clover seed on yield of crop.
	Chemistry .....	Available plant food in soils.
	Entomology .....	San Jose scale and Asiatic ladybird.
	Experiment Stations .....	Irrigation investigations.
Oregon (Union).....	Chemistry .....	Sugar-beet investigations.
Pennsylvania .....	Animal Industry .....	Investigations in animal nutrition with respiration calorimeter constructed by Bureau.
	Chemistry .....	Available plant food in soils.
South Carolina .....	Chemistry .....	Available plant food in soils.
South Dakota .....	Plant Industry .....	Variety tests of vegetables.
	Plant Industry .....	Improvement of wheat industry of Northwest.
	Chemistry .....	Available plant food in soils.
	Experiment Stations .....	Irrigation investigations.
Tennessee .....	Plant Industry .....	Cereal investigations, grass, forage, and other crops.
	Plant Industry .....	Influence of origin of red-clover seed on yield of crop.
Texas .....	Plant Industry .....	Improvement of wheat industry in middle States of Great Plains, establishment of macaroni wheats, etc.
	Chemistry .....	Influence of environment on sugar content of muskmelons.
	Chemistry .....	Available plant food in soils.
	Entomology .....	Mexican cotton boll-weevil.
	Entomology .....	San Jose scale and Asiatic ladybird.
Utah .....	Plant Industry .....	Cultivation of hemp.
	Plant Industry .....	Grasses and forage plants for arid and alkali soils.
	Chemistry .....	Sugar-beet investigations.
	Chemistry .....	Available plant food in soils.
	Soils .....	Alkali soils, seepage, and drainage investigations.
Vermont .....	Plant Industry .....	Drug-producing plants.
	Plant Industry .....	Experiments to determine amount and quality of grass and forage plant seeds offered for sale in Vermont.
	Chemistry .....	Available plant food in soils.
	Forestry .....	Tree-planting experiments.
	Experiment Stations .....	Nutrition investigations.
Virginia .....	Chemistry .....	Sugar-beet investigations.
	Chemistry .....	Methods of manufacture of cider.
	Chemistry .....	Available plant food in soils.
	Entomology .....	San Jose scale and Asiatic ladybird.
Washington .....	Plant Industry .....	Improvement of Northwestern ranges.
	Plant Industry .....	Cereal investigations and forage and other crops.
	Chemistry .....	Available plant food in soils.
	Experiment Stations .....	Irrigation investigations.
West Virginia .....	Plant Industry .....	Influence of various combinations on the three important elements of plant food—nitrogen, potash, and phosphoric acid.
Wisconsin .....	Public Road Inquiries.....	Building an experimental macadam road.
	Plant Industry .....	Influence of origin of red-clover seed on yield of crop.
	Plant Industry .....	Cereal investigations and forage and other crops.
	Chemistry .....	Available plant food in soils.
	Chemistry .....	Sugar-beet investigations.
	Experiment Stations .....	Irrigation investigations.
Wyoming.....	Chemistry .....	Available plant food in soils.
	Chemistry .....	Sugar-beet investigations.
	Experiment Stations .....	Irrigation investigations.

### AMERICAN INSTITUTIONS FOR AGRICULTURAL EDUCATION.

There never has been a year of more encouraging progress in agricultural education than the one just closed. The colleges in many instances have been given greatly increased resources. Much attention has been paid to the reorganization and specialization of collegiate courses in agriculture and to the preparation of teachers for the giving of instruction in nature study, school gardening, and other phases of elementary agriculture; agricultural high school courses have been



organized in a number of agricultural colleges; additional separate agricultural high schools have been provided for; at least one centralized high school has employed an agricultural college graduate to give instruction in agriculture, and a great wave of interest in nature study and gardening for the common schools has swept over the eastern half of the United States from north to south, with the result that these subjects are being taught in scores of city, village, and rural schools, and that in several places clubs of farmers' boys have been organized for the purpose of cooperating with agricultural colleges and experiment stations in conducting simple experiments in agriculture. So great is the interest manifested in these features of education that not only the agricultural colleges, but also many State normal schools and State departments of public instruction are giving attention to them.

This Office is in various ways aiding the movement for the better organization of our system of agricultural education. Part of this work is being done in cooperation with the Association of American Agricultural Colleges and Experiment Stations, the Director of this Office being chairman of the standing committee on methods of teaching agriculture. An article summarizing important features of recent progress in agricultural education was published in the Annual Report of this Office for 1902. In this article special attention was given to fundamental questions regarding the more definite formulation of the science of agriculture and the construction of courses of different grades based on this science. Mr. D. J. Crosby, of this Office, is especially engaged in keeping a current record of the progress of agricultural education in this country and abroad, and is also giving particular attention to the organization of nature-study courses on an agricultural basis in both rural and city schools. The calls for lectures on these subjects before teachers and others interested in this movement have been more than could be met, but the Office has been represented at a number of important meetings during the past year in different parts of the country.

It is very important that our educators should be brought into direct contact with those who are working on the problems of agriculture in this Department and in the agricultural colleges and experiment stations. They should also be informed regarding the publications of our agricultural institutions and receive instruction on agricultural subjects through correspondence, lectures, and otherwise. In this formative period of our system of agricultural education, especially as related to our secondary and elementary schools, it is believed that it is very appropriate and important that this Department should give much attention to arousing and guiding public sentiment and the educational forces of the country along those lines of education which are of vital importance to the material interests of our agriculture and the highest welfare of our rural population. With the advancement of scientific research in agriculture it is of the greatest importance that our agricultural people shall receive in the schools sufficient agricultural instruction to enable them to understand and apply the results of the work of such institutions as this Department and the experiment stations. The consideration of these educational problems from the standpoint of the needs of our agriculture as interpreted by science is therefore a legitimate part of the business of this Department and an efficient means for securing a more thorough dissemination of the results of its scientific and practical investigations.

## GRADUATE INSTRUCTION IN AGRICULTURE.

The need of enlarged facilities for the advanced training of agricultural experts is still apparent. This Department is doing considerable work in this line, and some of the stronger agricultural colleges are offering graduate courses to a limited extent. It was hoped that some arrangement might be made for continuing the Graduate School of Agriculture, which was so successfully inaugurated at the Ohio State University in the summer of 1902, as stated in my previous report. Thus far, however, none of the agricultural colleges has found it feasible to devote sufficient funds to this undertaking to insure its success. The executive committee of the Association of American Agricultural Colleges and Experiment Stations is now considering the matter and will present its conclusions to the next convention of the association, which meets at Washington this fall. If this school could have an assured income of \$5,000 per annum it would be possible to put it on a permanent basis. In view of the National character of this enterprise and its intimate relation to the continued success of the institutions endowed by the National Government, it would seem a proper and reasonable thing for Congress to make an appropriation for the maintenance of the Graduate School.

## THE COLLEGES.

Special appropriations for the better equipment and maintenance of agricultural colleges, aggregating more than \$1,250,000, have been made. Among the leading items in these appropriations are the following: Colorado Agricultural College has just completed a number of barns and has an appropriation of \$40,000 for a building to house the departments of civil and irrigation engineering. Delaware College has been given \$15,000 for two years for new buildings and facilities for teaching agriculture, the University of Idaho \$10,000 for improvements and repairs, and the Illinois College of Agriculture \$50,000 for equipment and instruction in agriculture. The Iowa State College is constructing a \$35,000 farm mechanics' building, a \$12,000 judging pavilion, and greenhouses for the departments of horticulture and agronomy to cost \$8,000. The Kansas Agricultural College has \$240,260 for buildings and maintenance for the next two years; the Missouri College of Agriculture \$62,600 for buildings and other improvements; the Montana State College of Agriculture \$215,000 for new buildings; the University of Nebraska \$100,000 for buildings and improvements; the New Hampshire College of Agriculture \$40,000 for buildings, repairs, and general expenses; the New Mexico College of Agriculture \$25,000 for buildings; Clemson Agricultural College of South Carolina \$40,000 for an agricultural building, and the Pennsylvania State College \$250,000, including \$100,000 for beginning the construction of an agricultural building to cost not more than \$250,000 with equipment and furnishings. The Wisconsin College of Agriculture has \$25,000 for equipping the new agricultural building just completed and \$15,000 for the erection of a farm-engineering building. The University of Wyoming has just come into possession of the penitentiary farm of 320 acres and the buildings located on it, which cost originally about \$100,000.

The Iowa State College of Agriculture and Mechanic Arts has com-

pletely reorganized its agricultural department and now offers four full four-year courses in agriculture, specialized along the lines of animal husbandry, agronomy, horticulture, and dairying. It has also provided a chair of farm mechanics in connection with the course in agronomy. The college of agriculture of Cornell University is also undergoing reorganization with a view to establishing well-equipped departments of agronomy, horticulture, animal husbandry, and rural economy. The Kansas Agricultural College now offers separate courses in agronomy, animal husbandry, and dairying; the Nevada State University has added a chair of animal husbandry, and the Missouri College of Agriculture has established what is thought to be the first laboratory of animal breeding in this country.

Following the lead of the successful schools of agriculture in Minnesota and Nebraska, the University of Maine, the Rhode Island College of Agriculture and Mechanic Arts, and the Oklahoma Agricultural and Mechanical College have organized two-year high-school courses in agriculture. The latter institution has also extended its collegiate course to five years and added a school of domestic economy. The Connecticut Agricultural College has arranged its courses in groups, thus providing a two-year group and a four-year group for graduates of high schools and a four-year and six-year group for graduates of the common schools. All of the groups require agriculture for graduation, and the four-year high-school group and the six-year common-school group lead to the degree of bachelor of science.

Increasing attention is given on the part of the agricultural colleges to the holding of summer schools, one purpose of which is to prepare teachers for giving instruction in nature study and elementary agriculture in the common schools. During the summer the Connecticut Agricultural College has held a summer school for teachers, having an enrollment of over 60; the North Carolina College of Agriculture and Mechanic Arts a summer school with an enrollment of 361 teachers, 140 of whom took work in agriculture and nature study; the University of Nebraska a summer school with an enrollment of 45 teachers; the University of Tennessee a summer school in which 180 teachers took work in agriculture, horticulture, and nature study, and the Hampton (Va.) Normal and Agricultural Institute a summer school with an enrollment of nearly 500 teachers, all of whom took instruction in either nature study or agriculture. The interest in work of this kind is especially strong in the South at this time, as is shown by the large enrollment of teachers in the Southern institutions.

The financial and statistical reports of the colleges receiving appropriations under the act of Congress of August 30, 1890, which, in accordance with the law, are regularly forwarded to the Secretary of Agriculture, have, as hitherto, been deposited in this Office. On the basis of these reports, this Office has published statistics relating to the land-grant colleges for the year ended June 30, 1902. These show that the aggregate value of the permanent funds and equipment of these colleges in 1902 was estimated to be \$67,544,888.25; their income, exclusive of the funds received from the United States for agricultural experiment stations (\$719,469.72) was \$9,166,272.82; the value of additions to their permanent endowment and equipment, \$3,413,202.96.

The number of persons in the faculties of the colleges of agriculture and mechanic arts having charge of preparatory classes and collegiate and special classes was 2,229, about one-sixth of this number being



engaged with the preparatory classes. In the other departments the faculties aggregated 1,050, making a grand total of 3,279 persons in the faculties of the land-grant institutions. The students in 1902 were as follows: (1) By classes—preparatory, 8,272; collegiate classes, 17,212; short course or special, 5,114; post graduate, 483; other departments, 16,334; total, 46,699. (2) By courses—agriculture, 6,299; veterinary science, 977; dairying, 1,372; mechanical engineering, 4,702; civil engineering, 2,146; electrical engineering, 1,814; mining engineering, 935; chemical engineering, 499; architecture, 336; household economy, 2,706; military tactics, 12,996. The graduates in 1902 were 4,443, and since the organization of these institutions, 50,026.

#### SECONDARY AND ELEMENTARY SCHOOLS.

The attendance at the two county agricultural high schools opened in Wisconsin in the fall of 1902 was large, and the interest manifested in these schools was so great that the State legislature at its last session, recognizing the demand for instruction of this grade, made provision for additional county agricultural high schools with State aid. At the California Polytechnic Institute, San Luis Obispo, buildings have been erected and everything put in readiness for opening the school with agricultural courses this fall. The Mount Harmon School, near Northfield, Mass., founded by the late D. L. Moody, has decided to establish an agricultural department and to offer courses of instruction in that subject. The school already has an equipment consisting of a farm of about 1,000 acres, a dairy of about 200 cows, fruit orchards, and a cannery for putting up vegetables. Mr. Harry Hayward, a graduate of the school and for several months past assistant chief of the Dairy Division of this Department, has been called to the school as director of the agricultural department. This step on the part of one of the largest secondary schools of the United States is a matter of great interest to those who are following the progress of secondary instruction in agriculture and is especially significant from the fact that the institution is not a technical school and that this is the first attempt to establish an industrial course.

The committee on methods of teaching agriculture of the Association of American Agricultural Colleges and Experiment Stations made a report to the convention of this association held at Atlanta, Ga., in October, 1902, in which it showed that courses in agriculture could be introduced into the public high schools without any violent or radical reorganization of existing programmes for such schools. An article on the progress in secondary education in agriculture, prepared by the Director of this Office, was published in the Department Yearbook for 1902.

Many of the officials in charge of our public high schools and elementary schools are also considering the advisability of introducing agricultural subjects into the curricula of these schools, more especially by giving an agricultural trend to nature-study work. A consolidated school at Elyria, Ohio, has engaged the services of an agricultural college graduate for the purpose of introducing regular instruction in agriculture into this school. In Tennessee, 12 miles from Knoxville, land has been purchased and plans completed for the establishment of a central rural school. The property acquired contains 14 acres, which will be devoted to campus, garden, orchard, and model farm. The pupils will receive, in addition to a sound elementary education, instruc-

tion in growing farm crops, fruits, and flowers, and in poultry raising and dairying. Near Ann Arbor, Mich., and Springfield, Ill., rural schools have recently acquired land which is devoted to garden work and simple experiments for the instruction of the pupils. In Winnebago County, Ill., the county superintendent of schools is conducting a very active propaganda for the improvement of rural schools by means of school gardens, school-ground improvement, the organization of clubs of boys and girls for the growing of farm crops, etc. Many of the pupils are taken annually on an excursion to the College of Agriculture at Urbana, the authorities of which undertake to direct the school children in their experiments in growing crops. During the past year school gardens were conducted in connection with about 15 rural schools in the county, and in many other places flowers, plants, and trees were set out for the improvement of school grounds. In the spring of 1903 every township in Winnebago County had a graduation exercise with a programme full of subjects relating to the beautifying of school grounds. There are also a number of agricultural clubs of boys and girls in Ohio who are in close touch with the College of Agriculture of the Ohio State University.

These are a few instances of activity in promoting agricultural instruction and school-garden work in connection with the rural schools. In the city schools activity along the line of school-ground improvement and school gardens has been even more apparent. Mr. D. J. Crosby, of this Office, acting as chairman of a committee on school grounds for the American Park and Outdoor Art Association, prepared a report which was presented at the convention of that association at Buffalo in July of the present year. The subject of school gardens was summarized in the report as follows:

School gardens, meaning by the term flower and vegetable gardens utilized for educational purposes, \* \* \* are found in the East, the Middle West, the South, the Far West, and our insular possessions. They are maintained in connection with the kindergarten and with every other grade up to the high school. However, the really significant and permanently valuable feature of recent progress in this connection lies not so much in the extent of the movement or in the grade of instruction as in the fact that school gardens are being started in connection with fifteen or twenty normal schools, that the officers of ten or twelve agricultural colleges are preparing school-garden plans and courses and otherwise cooperating in the work, and that departments of public instruction all over the United States are displaying much interest and activity in the school-garden improvement. In this way preparation is being made for putting school-garden instruction on a pedagogical basis. Nearly every new educational movement has its fad or sprout stage, during which it makes a luxuriant growth in the sunshine of popular favor, and is only saved from breaking down of its own weight by the level-headed few who possess not only enthusiasm, but the necessary native ability and persistence to make the thing succeed. This is followed by a period of reaction, of cutting back, during which, if unworthy, it dies, or, if worthy, it takes root deep in the rich earth of our existing educational institutions and prepares for a less showy but strong and vigorous growth. It is encouraging, therefore, to note that in so many of our leading educational institutions preparations are already being made to give adequate and intelligent support to the school-garden movement, to prepare teachers who shall be able to make the school garden truly an educational feature of the school.

This Department has been aiding the school-garden movement in several ways. Through the Bureau of Plant Industry it has distributed special packages of vegetable and flower seeds to a large number of schools, and conducted a number of school-gardening experiments in cooperation with the schools and charitable organizations of this city. Officers of the Department have in several instances volunteered to direct these experiments outside of office hours. One of the

most successful of these experiments was conducted on the Department grounds with a class of 30 boys and girls from a near-by school, under the direction of the science teacher in the Normal School of the city.

Members of the staff of the Office of Experiment Stations have given advice and assistance to a large number of teachers and school officers on the subjects of nature study, school gardening, and others closely related. The correspondence of the Office on these subjects included over 350 letters and replies. Members of our staff have also been called upon frequently to give addresses along this line before meetings of teachers, patrons of schools, and school children.

The Department is planning to cooperate with the director of the Hartford (Conn.) School of Horticulture and officers of the city schools of St. Louis, Mo., in conducting model school gardens at the Louisiana Purchase Exposition. Ground for the purpose is now being brought into proper condition. It is planned to have classes of volunteers from the city schools engaged daily in garden work on the Exposition grounds.

#### ASSOCIATION OF AMERICAN AGRICULTURAL COLLEGES AND EXPERIMENT STATIONS.

The sixteenth annual convention of this association was held at Atlanta, Ga., October 7 to 9, 1902. The Director of this Office was a delegate and was reelected bibliographer of the association. A number of other officers of the Department attended the convention and took part in the proceedings. A stenographic report of the proceedings was prepared under the supervision of the Director, and has since been edited by him and Mr. W. H. Beal, of this Office, and the chairman of the executive committee of the association, and issued as Bulletin 123 of the Office of Experiment Stations. Reports were made by the committees on methods of teaching agriculture, indexing agricultural literature, and graduate study at Washington. The Director of this Office has performed a considerable amount of work during the past year as a member of these three committees. He also presented at the convention a report on the Graduate School of Agriculture at Columbus. Regarding this school the executive committee presented the following report, which was subsequently adopted:

The executive committee regards it as extremely desirable that the Graduate School be continued, and recommends that the association assume the necessary expense of maintenance, less such amount as may be voluntarily contributed by the institution at which the school is from time to time held.

Second. The committee further recommends that the executive committee be authorized to assess upon each college or university represented in the association its proper annual contribution in proportion to its income.

Third. That this assessment may take the form of a scholarship or scholarships to be maintained in the name of the contributing institution.

The attitude of the association regarding the efforts of this Department to aid farmers' institutes was indicated by the adoption of the following resolution:

*Resolved*, That this association express to the honorable Secretary of Agriculture its indorsement of his plans for the promotion of the interests of the farmers' institute throughout the country, and assure him of its active cooperation in his efforts to secure adequate financial support for this enterprise.



Regarding the annual report of this Office the association adopted the following resolution:

Whereas the interests of the institutions represented in this association demand that the Annual Report of the Office of Experiment Stations on the work and expenditures of the agricultural experiment stations should be published promptly each year: Therefore, be it

*Resolved*, That the executive committee be, and hereby is, instructed to use its best efforts to secure action by Congress which will insure the annual printing of a suitable edition of the report for distribution to the officers of the colleges and stations.

The association put itself on record as favoring increased Government funds in the aid of the agricultural experiment stations by the adoption of the following resolution:

Whereas the sum provided by the Hatch Act of 1887 for the organization of agricultural experiment stations and the beginning of investigations in American agriculture has become insufficient for the questions now pressing for solution; and

Whereas the work of the stations during the fifteen years of their existence and the increased number of questions propounded for their solution are conclusive evidence of their public utility: Therefore, be it

*Resolved*, That the executive committee is hereby instructed, if in its judgment it should seem expedient, to urge upon Congress at the earliest practicable date that the appropriation to the several States under the Hatch Act be increased by the sum of \$15,000 annually.

A committee on agricultural engineering was appointed in accordance with the following resolution adopted by the association:

Whereas the agricultural colleges and experiment stations, as well as the United States Department of Agriculture, are broadening their work relating to irrigation and farm machinery and other lines of agricultural engineering, and there is pressing need of the more definite formation of plans for this work: Therefore, be it

*Resolved*, That this association make provision for the appointment of a standing committee on agricultural engineering, to consist of five members, and that it be made the duty of this committee to cooperate with the Department of Agriculture in promoting education and research along the different lines of agricultural engineering.

Quite a large number of topics of general interest were discussed at the general session and section meetings of the association. The Director of this Office presented a paper on The Graduate School of Agriculture as a Means of Improving the Pedagogical Form of our Courses in Agriculture. The president of the association in his annual address gave a review of the progress made in various lines of industrial education, including that of the agricultural colleges and experiment stations, agricultural high schools, short courses, farmers' institutes, and the Graduate School of Agriculture at Columbus. He also emphasized the importance of giving attention to elementary instruction in agriculture in the rural schools.

#### THE EXHIBIT OF THE AGRICULTURAL COLLEGES AND EXPERIMENT STATIONS AT THE LOUISIANA PURCHASE EXPOSITION.

This Office is now in the midst of preparations for exhibits illustrating in two ways the progress of the movement for agricultural education and research in the United States at the Louisiana Purchase Exposition at St. Louis in 1904. First, as a branch of the Department of Agriculture, the Office will make an exhibit showing its functions as a governmental agency for the promotion of agricultural education and research in intimate relation with the State institutions for these purposes, and for the management of the experiment stations in Alaska, Hawaii, and Porto Rico, and of special investigations on human nutri-

tion and on irrigation. This exhibit will be made in the Government building and will be under the immediate direction of Dr. Walter H. Evans.

Secondly, the Office will share in the preparation of an exhibit to be made under the auspices of the Association of American Agricultural Colleges and Experiment Stations which is intended to illustrate the progress of the institutions established under the acts of Congress of July 2, 1862, March 2, 1887, and August 30, 1890, especially as regards education and research in agriculture and mechanic arts.

A movement to install at the Louisiana Purchase Exposition a collective exhibit of the work of the land-grant colleges and agricultural experiment stations in education and research was instituted at the 1901 meeting of the association in Washington, and two committees were appointed to consider the matter, one representing agriculture and another mechanic arts. At the Atlanta meeting, in 1902, these committees reported in favor of an exhibit. The two committees were consolidated into one as an exposition committee, and the executive committee was charged with the duty of soliciting from Congress the sum necessary to meet the expense of installing and maintaining the exhibit of the distinctive work of the land-grant colleges and experiment stations. This committee is as follows:

Dr. W. H. Jordan, chairman, director of the New York State Agricultural Experiment Station; Dr. A. C. True, secretary, Director of the Office of Experiment Stations, U. S. Department of Agriculture; Dr. W. T. Harris, Commissioner of Education; Prof. H. J. Waters, dean of the College of Agriculture and Mechanic Arts of the University of Missouri, and director of the Missouri Agricultural Experiment Station; Prof. W. M. Hays, professor of agriculture in the College of Agriculture of the University of Minnesota, and agriculturist of the Minnesota Agricultural Experiment Station; Dr. W. E. Stone, president of Purdue University; Prof. T. F. Hunt, professor of agronomy, Cornell University; Prof. C. F. Curtiss, professor of agriculture, Iowa State College of Agriculture and the Mechanic Arts, and director of the Iowa Agricultural Experiment Station; Dr. J. K. Patterson, president of the Agricultural and Mechanical College of Kentucky; Prof. H. W. Tyler, professor of mathematics, Massachusetts Institute of Technology.

The appeal to Congress met with a very liberal response, and \$100,000 was appropriated for this purpose. The association's exhibit was by act of Congress made a portion of the Government exhibit at the Louisiana Purchase Exposition, and the management of the exhibit and the National funds therefor were intrusted to the Government board. The expenditure of the appropriation was, however, conditioned on the promise of the Louisiana Purchase Exposition Company to furnish suitable accommodations for the exhibit in its own buildings. This promise the exposition company promptly gave, and the Government board therefore at once began to perfect an organization for carrying into effect the act of Congress relating to this exhibit. For this purpose the board recognized the committee of the association as being the proper persons to have the more direct management of this exhibit. The members of the committee were made agents of the board, and on the nomination of its chairman, the secretary of the committee was constituted the special representative of the committee in its relations with the board, and was made responsible for the proper

expenditure of the funds granted by Congress for this purpose. To have immediate charge of the business relating to this exhibit, Mr. James L. Farmer, of Tennessee, who has had much successful experience in connection with previous expositions, was appointed chief special agent, and room was provided for him in this Office. Members of the Office force are participating to a considerable extent in the work connected with this exhibit.

A plan for the exhibit has been formulated, and negotiations are actively progressing for the preparation of different features of the exhibit by the colleges and stations throughout the country. A special effort will be made to impress the educational forces of the country with the importance and success of the movement on behalf of agricultural education and research in this country, and to this end arrangements have been made with the exposition company to install the main exhibit in the Palace of Education. Certain practical features of the work of the colleges and stations, as relating especially to the live-stock industry, will, however, be illustrated in a special pavilion to be erected in the agricultural section of the Exposition.

From the foregoing statement it will be apparent that this Office will be called upon to perform a large amount of work in connection with the St. Louis Exposition. This work will cover all the current fiscal year and more than half the succeeding year. To perform this work with its present force and resources the Office will be compelled to defer some work which it might otherwise perform in the interests of the colleges and stations.

#### RELATIONS WITH FOREIGN INSTITUTIONS.

The work of preparing a card catalogue of foreign agricultural institutions and of revising Bulletin 112, Agricultural Experiment Stations in Foreign Countries, has been continued. Considerable activity in the organization and broadening of institutions for education and research in agriculture has been manifested in different countries.

In Japan the successful work of the local agricultural experiment stations has made it possible for the ministry of agriculture and commerce to reduce the number of branch experiment stations connected with the Central Agricultural Experiment Station at Nishigahara, and to concentrate its efforts and funds on a smaller number of stations and fewer lines of work. The funds available for research, \$91,920, are now divided among the Central Agricultural Experiment Station and three branch stations, instead of nine branch stations as formerly. The island of Formosa has established three agricultural experiment stations and a tea experiment station under control of the bureau of industries of Formosa.

In southern and eastern Africa quite a number of new agricultural institutions have been organized. The government of Rhodesia has organized an independent department of agriculture at Salisbury under the direction of a secretary of agriculture, Mr. E. Ross Townsend. The department staff includes an agriculturist, a register of brands, a chief veterinary surgeon and five assistant surgeons, and a staff of clerks. It has recently established an experiment station about 2 miles from Salisbury which will be devoted largely to experiments with field crops and plant diseases. In the Transvaal an agri-



cultural department has been established at Pretoria, under the directorship of Prof. F. B. Smith, formerly of the Southeastern Agricultural College at Wye, England. The work of the department will include studies and investigations upon various problems connected with agriculture, such as animal and plant diseases, injurious insects, soils, the use of fertilizers, irrigation, breeding, poultry farming, dairying, etc. The department has begun the publication of an official quarterly periodical known as the Transvaal Agricultural Journal. The government of German East Africa has established a biological agricultural institute at Amani, with Prof. A. Zimmermann as director and botanist.

In Russia considerable attention is being given to the promotion of agricultural education of intermediate grade. A new school, making the eighth of this class under the jurisdiction of the ministry of agriculture, has recently been opened near the city of Pskov. Agricultural courses for women have also been opened at the Imperial Botanical Gardens at St. Petersburg. These courses include horticulture and gardening, dairying, poultry raising, and beet culture, and were organized by the Society for the Promotion of Female Agricultural Education. The same society has secured the establishment of similar courses at the Mariinsk Agricultural School. Agricultural instruction is also provided for teachers in primary public schools, educated persons other than teachers, peasants, and other persons interested in agriculture, and soldiers who are stationed near an agricultural school.

Plans have been made and a committee appointed to formulate and install a system of agricultural education in the primary schools of the island of Reunion. In England a school of practical and scientific horticulture, known as the Middlesex County Council School of Horticulture, has been established at Pymmes Park, Edmonton. In Germany the Halle Experiment Station has been reorganized and divided into three parts—an agricultural experiment station, a control station, and a botanical station. The German Government has appropriated \$15,000 for studying the relation between tuberculosis in man and in cattle.

#### THE FARMERS' INSTITUTES.

In consequence of the action of Congress during the session of 1902-3 making definite provision for the work of this Office relating to Farmers' Institutes, it has been possible to put this work on a permanent basis and to begin the formulation of a policy regarding its development. As the intention of Congress to favor this enterprise had been revealed at the previous session, arrangements were made with the Civil Service Commission to hold a special examination for a farmers' institute specialist to take charge of this work as a regular member of the staff of this Office. As the result of this examination Prof. John Hamilton, of Pennsylvania, was appointed to this position. Professor Hamilton has had a long and successful experience in connection with the Pennsylvania State College and department of agriculture. He has been for many years a lecturer and manager of farmers' institutes and is thoroughly acquainted with their past development and their present needs. He also thoroughly understands the relation of the institutes to the general movement for agricultural education and to the agricultural colleges and experiment stations. He is thus qualified to enter on efficient work in this new position without delay.

Since the funds available for this work during the fiscal year 1903 were very limited it was not feasible to have the farmers' institute specialist report for duty prior to April 1, 1903, and this report therefore covers only the fourth quarter of the fiscal year.

Taking as a basis the limited data regarding the status of the institutes in the several States and Territories, which the Office had hitherto collated, he immediately began to seek more detailed and satisfactory information through correspondence with the farmers' institute directors throughout the country. A compilation of the laws under which the institutes are conducted was also undertaken. Arrangements were made for the systematic and permanent recording of the information acquired. Opportunities for studying the problems of the institutes in different parts of the country have been taken advantage of as they have presented themselves, and for this purpose this officer has already visited a number of States and taken part in the annual meeting of the American Association of Farmers' Institute Workers.

Since the work of this Department relating to the farmers' institutes is based on the principle of giving aid to the institutions maintained under the authority of the States, this Office has established the rule of working in this line through the State officers charged with the management of the institutes. It is the intention to consult freely with these officers, to welcome suggestions from them regarding the development of our work, and to recognize them as the proper authorities through whom to deal in matters relating to the institutes in the several States. It is our purpose to endeavor to strengthen the State organizations for the management of the institutes, and to create a National system of institutes by promoting the reasonable coordination of the work throughout the country, and the cooperation of the State organizations without weakening or destroying their autonomy.

Considering the conditions under which our work must be performed, it is our intention to concentrate our efforts for the present on a few of the most pressing lines in which it appears that the institutes need the aid of this Department. It is generally agreed among institute managers that the most urgent problem in institute work just now relates to the securing and maintaining of an efficient corps of institute lecturers. The longer farmers attend the institutes the more they demand that the lecturers shall not confine themselves to stating individual experiences, however successful these may have been, but shall interpret to them the teachings of wide practical experience as related to the results of experimental investigations conducted under scientific direction. This means that the lecturers must be constant students of the progress of practical and scientific agriculture. They must therefore have the means of acquainting themselves readily and satisfactorily with what is going on throughout the world in the line of their specialties. Besides this, they must be provided with the best facilities for the clear presentation of their subjects to their audiences. This means that they must have the right kind of specimens, charts, photographs, lantern slides, etc.

This Office, therefore, intends to give much attention to whatever concerns the best training of the farmers' institute lecturers. It will also aid the institute managers to secure the best available lecturers in the different branches of agriculture. With these ends in view the farmers' institute specialist has asked the State directors to furnish this Office with the names of lecturers who have been in their employ

during the past year. This list aggregates over 800 names. It has now been printed and sent to the State experiment stations with the suggestion that as far as practicable these lecturers be furnished regularly with the station publications. They will also be furnished with the publications of this Department suited to their needs. They will be encouraged to correspond freely with this Office, and special pains will be taken to secure prompt and satisfactory answers to their inquiries. They will be furnished with lists of books relating to their specialties, and their attention will be called to the reports issued by State departments of agriculture and agricultural societies. It is also hoped that it will be possible to arrange for an annual meeting of lecturers at Washington for conference, and especially for study of the work of this Department. Individual lecturers will, of course, be welcomed at the Department at any time.

Two other lines of work for the benefit of the institute lecturers, which have been suggested by the farmers' institute specialist, are in my judgment very important, but will require additional funds for their satisfactory accomplishment. One of these suggestions is that a systematic course of instruction for institute lecturers be laid out and carried on by correspondence. This would doubtless be of great advantage to the institutes, but would require the services of a competent officer to arrange and superintend the course, and clerical assistance to manage the details. The other suggestion, which is intimately connected with the first, is that the Department furnish charts, photographs, and lantern slides for the illustration of institute lectures. To do this in an extensive way would involve considerable expense, and yet its importance will justify an attempt to meet the needs of the lecturers for these things in a reasonable degree. To test this matter a beginning of work in this line has already been undertaken, but it is evident that we can not go far in this direction with our present resources.

In view of the importance of these two lines of work, I recommend that an additional appropriation of \$5,000 be asked for to enable the Office to extend its work, especially that relating to the 800 institute lecturers, on whom largely rests the responsibility of giving accurate and practically valuable information to 1,000,000 farmers. A portion of this fund might be used in preparing and printing charts, photographs, and lantern slides for the use of these lecturers.

This Office will also aid both the State and local managers of the institutes. Some of the ways in which assistance will be given to State directors have been formulated by the farmers' institute specialist as follows:

- (1) By furnishing them with data respecting the methods of conducting the institute work in other States.
- (2) By keeping them informed in advance as to the places selected for institutes, the dates upon which they are to be held, and the speakers who are to be present, in all of the States.
- (3) By placing them in communication with the institute lecturers of the country.
- (4) By aiding them in securing the interest and cooperation of agricultural-college and experiment-station experts in their work.
- (5) By sending experts from the Department of Agriculture at Washington, or from such of the corps of agricultural-college and experiment-station men, as may be available, to assist them in their institutes.
- (6) By suggesting methods for local organization.
- (7) By educating lecturers for institute work by means of correspondence through the Office of Experiment Stations and by bringing them into communication with



experts to give them instruction in the latest and most reliable discoveries of science along the line of their specialties.

(8) By publishing an annual report giving a synopsis of the institute work, its character and progress in all of the States.

The Department can be of assistance to the local managers, through the agency of the State directors—

- (1) By sending them institute literature.
- (2) By suggesting effective methods for advertising institute meetings.
- (3) By furnishing model forms of programmes.
- (4) By suggesting topics for discussion.
- (5) By suggesting methods for creating and increasing interest in farmers' institutes.
- (6) By furnishing question-box material.
- (7) By calling attention to subjects that should be excluded from their institutes.

In the appropriation act making provision for the work of this Office in relation to the institutes, it is made our duty to bring the results of the work of this Department before the farmers attending the institutes. As a result of this provision we are already receiving numerous calls for the personal attendance of officers of the Department at the institutes. These calls are welcomed as evidences of the public interest in the work of the Department, and special pains are being taken to meet them satisfactorily as far as possible. In this way it may be expected that the Department will be much more generally represented at the institutes in the several States than it has been in the past, and the work of the Department will be explained to thousands of farmers who hitherto have had only vague understanding of its relation to practical agriculture. Since it is obviously impracticable for the Department to be personally represented at all the institutes, the plan will be followed of sending its representatives especially to the round-up institutes and such other meetings of large numbers of representative farmers as will be likely to secure the most effective dissemination of information regarding the Department's work in different sections of the country.

As regards the attendance of Department officers at the institutes, it is believed that the same policy should be followed as has long been recommended by this Office for the experiment station officers. It is well that agricultural scientists and experts should come into direct contact with practical farmers and be able to explain the results of their work in such a way as to justify them in the minds of practical men. For this purpose attendance at institutes is an excellent thing for both Department and station officers. This work should of course be so managed as not to interfere with, but rather promote, the interests of their investigations.

It is difficult to realize the extent and importance of the farmers' institute movement and its vital relation to the successful incorporation of the results of scientific investigations in our agricultural practice. Under present conditions, with the rapid changes in the personnel of our agricultural population and the almost entire absence of agricultural instruction in our elementary schools, it is of the greatest importance that our adult farmers shall receive definite information regarding improved methods of agriculture and the principles which lie at the foundation of progress in agricultural practice. Already it is estimated that nearly 1,000,000 of our farmers are reached at least to a limited extent by the institutes. To give this great body of men sound instruction and to bring the remaining 9,000,000 farmers of the United States within the direct influence of the institutes is a

vast undertaking. Considering the very limited funds which the institute managers have had at their disposal they have accomplished wonders. And when the public and our legislators understand the significance of the institute movement in its relation to the mental and material well-being of our people there will be no difficulty as regards funds for the proper development of the institutes.

It was doubtless necessary to gather the data for the science of agriculture through the work of this Department and the experiment stations, and to train the leaders of agricultural progress in our agricultural colleges before it was possible to put popular movements for agricultural education on an effective basis. But the time is now ripe for a great advance movement for the wide dissemination of agricultural knowledge among the masses of our people. Workers must be trained for this purpose, but they will come with the enlargement of the demand for them. Wise provision for the maintenance of these workers by Congress and the State legislatures will bear abundant results in popular approval and the advancement of the National interests. Intelligent and active leadership in this cause will prove very effective at this juncture, and all who are in a position to render valuable service in this line have good reason to believe that their efforts will be crowned with early success.

#### PUBLICATIONS OF THE OFFICE.

During the year the Office published 44 documents, aggregating 4,112 pages, a substantial increase over the output of the previous year. The publications issued include 13 numbers of the Experiment Station Record, 14 technical bulletins, 2 bulletins of the Porto Rico Experiment Station (English and Spanish editions), 2 reports, 4 Farmers' Bulletins (including 2 numbers of the subseries Experiment Station Work), 3 circulars, and 4 articles for the Yearbook of the Department. Two other numbers of the Experiment Station Record and 7 bulletins, containing 1,027 pages, were prepared and submitted for publication during the year. The policy of reprinting separates of individual articles contained in larger reports has been continued with the same satisfactory results as heretofore. Eighty-one such separates, aggregating 2,074 pages, have been reprinted in editions of varying size to meet the actual demand for the articles. Several documents formerly printed separately by Congress were combined in the Annual Report of the Office of Experiment Stations, as was done last year.

#### EXPERIMENT STATION RECORD.

The fourteenth volume of this periodical was issued during the past fiscal year, under the general editorial management of Dr. E. W. Allen, assistant director of this Office. It consisted as usual of twelve numbers of about 100 pages each, one of which was an index number, containing name and subject indexes. The month of issue has been placed on the individual numbers of this volume in response to frequent requests from the readers, who urged that the date would be a convenience and help to make the Record more useful as a current and permanent record of agricultural investigations. The irregularity in the amount of time required for publication in the past threw a doubt on the feasibility of this plan; but by using every effort to get

the individual numbers ready on a fixed date of the month, and to expedite the proof reading, the time required for printing has been shortened and made more nearly uniform. As a result the Record has been issued more regularly than ever before, and the dating of the numbers monthly has aided in bringing about this regularity.

The abstracting has also been brought more closely up to date, and the time elapsing between the appearance of scientific contributions in bulletins and periodicals and the publication of abstracts of them in the Record has been materially shortened. This is a very important matter as affecting the usefulness of the current review to the workers in our agricultural colleges and experiment stations, to whom prompt notice of new work is not only very desirable but highly important to their investigations. Nearly all the bulletins and reports and the periodicals detailing foreign investigations are now abstracted and ready for publication in the Record within about a month after their receipt at the Department. Lack of space still makes it necessary to hold back a small amount of material nearly every month, but the use of the smaller type and the condensation of the abstracts as far as possible have largely overcome the former delays due to lack of space; and this, with the shortening of the time required for publication of the individual numbers of the Record, has combined to make the review of American and foreign literature relating to agricultural science more closely up to date and more comprehensive. Evidences of appreciation of the efficiency which has been reached are numerous and come from agricultural investigators, teachers, and specialists in this and foreign countries. They show that the publication is fulfilling a very useful mission and is contributing its part toward the promotion of agricultural science and the improvement of practice.

The space given to editorials has been extended somewhat in the volume for the past year, as has also that devoted to news items and notes of special interest to our agricultural colleges and experiment stations. These notes have proved of much interest as a means of keeping posted on matters relating to the progress of agricultural instruction and the development of experimentation throughout the world, and have been very favorably commented upon. Special effort is made to have them authentic, and to verify reports before the items are published. The development of this feature of the Record has proved so popular that it will be further extended where possible.

A rather smaller number of special articles has been published than formerly. This is due to two things, the need of the space for abstracts and reviews, and the difficulty of securing articles suited to the present status of the experiment-station work. The work in this country is now well abreast of that in Europe in most particulars, and the methods employed are those which have been adapted to this country or developed here to suit the special requirements of our investigations.

It has been difficult to secure articles which were not too elementary for the present status of the work in this country, or which were sufficiently suggestive to investigators and not too restricted in scope to warrant giving up the space in the Record required for them.

Many of the general problems of station organization and development, which formerly were treated in special articles, have formed the text for editorials. These have discussed more briefly and with special application to our conditions many phases of station organization and management, the relations of the stations to agricultural edu-



cation and to the farmers' institute work, the popularizing of the station work and means of getting it before the farmers, new lines of work, increased support of the stations by the States, new developments abroad, the development of secondary instruction in agriculture, and similar matters closely related to the problems and the progress of agricultural education and experimentation. These notes are made timely, and represent the views of the Office respecting the policy of the stations and the development of their work and influence.

The fourteenth volume of the Record comprises 1,267 pages, of which 966 are devoted to abstracts, 46 to editorials, 74 to special articles, 54 to notes, and the remainder to lists of station and Department publications abstracted and name and subject indexes. The volume contains abstracts of 377 bulletins and 52 reports of experiment stations in the United States, 176 publications of the Department of Agriculture, and numerous reports of foreign investigations. The total number of abstracts is 4,620, classified as follows: Chemistry, 230; botany, 177; fermentation and bacteriology, 49; zoology, 51; meteorology and climatology, 102; air, water, and soils, 183; fertilizers, 184; field crops, 344; horticulture, 463; forestry, 199; seeds and weeds, 73; diseases of plants, 371; entomology, 371; foods and nutrition, 257; animal production, 344; dairy farming and dairying, 208; veterinary science and practice, 670; technology, 27; agricultural engineering, 158; statistics and miscellaneous, 159.

This volume also contains condensed accounts of the convention of the Association of Official Agricultural Chemists, 1902; International Conference on Plant Breeding and Hybridization, convention of the Association of American Agricultural Colleges and Experiment Stations, and the meeting of the American Association for the Advancement of Science as regards agricultural science; a description of the new buildings at the New Hampshire and Missouri agricultural colleges, and an article on Values in Science, by W. H. Jordan. The following topics are discussed in the editorials: Increased funds for station maintenance; education of the American farmer; Royal Society's catalogue of scientific papers; fiftieth anniversary of the first State experiment station; Prof. A. Petermann, founder of experiment-station system of Belgium; Jacob Richards Dodge, agricultural statistician; Virchow's service to agriculture, progress in plant breeding; Dr. Robert C. Kedzie, a pioneer in agricultural science; new yearbook of the Russian experiment stations; overworking among experiment-station men; need of extending the scope of station operations; some factors in research work; P. P. Deherain, deceased; agricultural experimentation in the Philippine Islands; the agricultural appropriation act, 1903-4; the Department publications; the soil survey in 1903; school garden at the Department of Agriculture; need of experiments with horses; an index catalogue for agricultural libraries; an index of scientific periodicals; memoir of the National Institute of Agriculture at Paris; progress of secondary education in agriculture; the exhibit of the land-grant colleges and the experiment stations at St. Louis, and conclusion of Volume XIV.

The largest undertaking connected with the Record has been the completion of the General Index to the first twelve volumes. This work, which has been in progress for some two years, has proved far more time-consuming and laborious than could be anticipated. It

covers the two parts of Experiment Station Bulletin No. 2, which contain the abstracts of the reports of the experiment stations for 1888, the first year after their organization under the Hatch Act, as well as Volumes I to XII of the Experiment Station Record. It therefore begins with the work of the experiment stations under the Hatch Act and covers the period down to the close of the century (the year 1900). The indexes to this work are contained in fourteen different volumes, many of them large and cumbersome to handle. In combining these indexes the entries have been systematized and extended, and every effort has been made to make the references complete under appropriate headings and easily found by means of cross references. The rearrangement of the entries in so voluminous an index and the attempt to bring about as large a degree of consistency as possible has required a large amount of very close work, and has consumed much time in supervision and execution. But there have been many calls for such a general index, the usefulness of which is universally conceded, and the effort which has been expended in completing and perfecting it is believed to have been fully warranted. It has resulted in reducing the number of entries very materially, which will reduce the expense of publication, and it will enable us to improve the indexing of individual volumes of the Record in the future. In its completed form, the index contains about 125,000 entries, and is undoubtedly the most extensive index to the literature of agricultural experimentation which has ever been issued.

#### MISCELLANEOUS PUBLICATIONS.

The miscellaneous publications of the Office consist chiefly of (1) technical bulletins and reports and (2) Farmers' Bulletins, including the series known as Experiment Station Work. The editorial work involved in the preparation of these publications for submission to the Division of Publications constitutes the business of the editorial division of this Office, of which Mr. W. H. Beal is chief.

The publications on the subjects of nutrition and irrigation issued by the Office during the year are noted on pages 298 and 324, respectively.

#### TECHNICAL BULLETINS.

Proceedings of the Fifteenth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, held at Washington, D. C., November 12-14, 1901, edited by A. C. True and W. H. Beal for the Office of Experiment Stations, and H. H. Goodell for the association. (Bulletin No. 115, pp. 134, fig. 1, charts 8)

Proceedings of the Seventh Annual Meeting of the American Association of Farmers' Institute Workers, held at Washington, D. C., June 24, 25, and 26, 1902, edited by A. C. True and D. J. Crosby for the Office of Experiment Stations, and G. C. Creelman for the association. (Bulletin No. 120, pp. 119.)

Organization Lists of the Agricultural Colleges and Experiment Stations in the United States (Bulletin No. 122, pp. 96) contains the staff of the Office of Experiment Stations; lists of officers of the Association of American Agricultural Colleges and Experiment Stations; Association of Official Agricultural Chemists of the United States; Association of Economic Entomologists; and American Association of Farmers' Institute Workers; and a list of agricultural colleges and

experiment stations in the United States, with governing boards, courses of study, boards of instruction, and station staffs. The bulletin also contains a complete index of names.

Proceedings of the Sixteenth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, held at Atlanta, Ga., October 7-9, 1902, edited by A. C. True and W. H. Beal for the Office of Experiment Stations, and H. C. White for the association. (Bulletin No. 123, pp. 144, pls. 2.)

A Digest of Recent Experiments on Horse Feeding, by C. F. Langworthy (Bulletin No. 125, pp. 75), discusses the principles of nutrition with especial reference to horses, as well as the comparative value of feeding stuffs, methods of feeding, digestibility of feeding stuffs, watering, muscular work and its effect on food requirements, and related topics, the attempt being made to summarize available information on the subject, especially that afforded by the studies carried on at the experiment stations in the United States. Data were also collected showing the rations fed by express companies, cab companies, and others using large numbers of horses, and these rations are compared with those fed the farm horses of the experiment stations, army horses, etc.

Statistics of the Land-grant Colleges and Agricultural Experiment Stations in the United States for the year ended June 30, 1902 (Bulletin No. 128, pp. 38), shows the number of officers and students, endowment, equipment, and revenue of the colleges, and the number of officers, revenues, expenditures, lines of work, additions to equipment during the year, and number of publications of the stations.

#### REPORTS.

Report of the Director of the Office of Experiment Stations for 1902, by A. C. True (Annual Reports, U. S. Department of Agriculture, pp. 241-304), contains a summary of the work of the Office during the year.

Annual Report of the Office of Experiment Stations for the year ended June 30, 1902 (U. S. Department of Agriculture, Office of Experiment Stations Report, 1902, pp. 547, pls. 48, figs. 2), contains reports on the work and expenditures of the agricultural experiment stations in the United States for the fiscal year ended June 30, 1902, including a review of the work of this Office; summarized accounts of the meetings of the Association of American Agricultural Colleges and Experiment Stations and the American Association of Farmers' Institute Workers held in 1902; a list of the publications issued by this Office and the experiment stations during the calendar year 1902; Federal legislation, regulations, and rulings affecting agricultural colleges and experiment stations; annual reports of the Alaska, Hawaii, and Porto Rico experiment stations; a review of irrigation investigations for 1902, and several articles relating to nutrition investigations, agricultural education, and cooperative experiments. Some features of recent progress in agricultural education are set forth in an article by A. C. True, in which an account is given of the Graduate School of Agriculture held at the Ohio State University in July, 1902. The educational values of courses in agriculture are discussed at some length, and examples are given of present courses in agriculture in colleges, secondary agricultural schools, and town high schools. A general



survey of the farmers' institute movement in the United States and of the work and appropriations in each State during the year is given in an article by D. J. Crosby. The publication of popular editions of station bulletins is discussed in an article by F. H. Hall. An account is given of the origin, history, and present status of the movement for cooperation between the experiment stations and farmers, and concrete examples are cited. Cooperative experiments in Alabama are reviewed by J. F. Duggar, in Illinois by E. Davenport, in New York by J. L. Stone, and in Canada by C. A. Zavitz.

## FARMERS' BULLETINS.

Silos and Silage (revised edition), by C. S. Plumb (Farmers' Bulletin No. 32, pp. 32, figs. 6). This bulletin was thoroughly revised and in large part rewritten.

Experiment Station Work, XXI and XXII (Farmers' Bulletins Nos. 162, pp. 32, figs. 3; 169, pp. 32, figs. 6), embody in popular form some of the more important practical results of the work of the experiment stations in this and other countries.

Principles of Horse Feeding, by C. F. Langworthy (Farmers' Bulletin 170, pp. 44). The general principles of feeding are discussed with special reference to horses, and the results of recent experimental work, particularly that carried on at the experiment stations of the United States, are summarized. The material in its present form is very largely an abridgment of Bulletin No. 125 of this Office.

## YEARBOOK ARTICLES.

Progress in Secondary Education in Agriculture, by A. C. True (Yearbook of the Department of Agriculture, 1902, pp. 481-500, pls. 2). This discusses the present status of the high schools as regards industrial education, describes the schools of agriculture of a secondary grade already established, and makes suggestions for courses in agriculture in the public high schools.

Some Practical Results of Experiment Station Work, by W. H. Beal (Yearbook of the Department of Agriculture, 1902, pp. 589-606). Specific examples are given to show the character and extent of the influence of the experiment stations upon agricultural practice.

## CIRCULAR.

Secondary Courses in Agriculture, by A. C. True et al. (Circular No. 49, pp. 10). This is an extract from the seventh report of the committee on methods of teaching agriculture of the Association of American Agricultural Colleges and Experiment Stations. The feasibility of establishing agricultural courses in high schools is shown, and several such courses suited to different high schools are suggested.

## CARD INDEX.

Copy for 1,700 cards of the index of experiment station literature was prepared in the Office and forwarded to the Division of Publications during the year. The number of index cards distributed has reached 23,000. The receipts from sales of the index during the year were \$157.05.

## BIBLIOGRAPHICAL WORK.

The Office has cooperated with the Library of the Department in the preparation of a list of references to publications relating to irrigation and land drainage, which was published as Library Bulletin No. 41. The Office is also cooperating with the Library in the preparation of author and subject indexes in card form to the more important articles in the leading agricultural journals. Considerable additions have been made to the bibliography of nitrogen assimilation and to the bibliography of the nutrition of man and animals, especially as related to the feeding of horses. A bibliography of the literature of plants poisonous to stock is also being prepared in the Office. A list of bibliographies relating to agriculture, which appeared during the year, has been prepared for the report of the bibliographer of the Association of American Agricultural Colleges and Experiment Stations as in the past. The Office has frequently prepared lists of references along different lines for station workers, which service has been greatly appreciated. The compilation of ash analyses of American farm products has been extended.

The collection of station publications has been continued as heretofore and additions have been made to the sets of Department and station publications at the Alaska, Hawaii, and Porto Rico stations. A large number of foreign publications of all kinds has been received as exchanges. Many duplicates of station and other publications were received, a considerable number of which were distributed to college and station libraries and officers.

## WORK FOR THE CIVIL SERVICE COMMISSION.

The Director of this Office has continued to act as the general representative of the Department in matters relating to examinations held by the Civil Service Commission for technical and scientific positions in the Department. The number of papers received from the Civil Service Commission, recorded in this Office, and rated by examiners in the Department during the year was about 873, as compared with 490 last year. Besides the regular examinations, 47 special examinations were held during the year, as compared with 37 the previous year.

The greatest difficulty in securing satisfactory employees for the varied business of the Department from the regular registers of the Commission arises in respect to classes of employees whose work is either a mixture of clerical and manual duties or clerical duties which involve a certain amount of special knowledge. It is believed that this difficulty might at least in a measure be removed if the Commission would further extend its registers of skilled laborers to meet the special requirements of this Department and would oblige candidates for positions as clerks, typewriters, and stenographers to state in detail their educational qualifications, and their knowledge and experience as regards languages, sciences, manual arts, bookkeeping, etc., with the understanding that such statements would affect their certification. For example, in this Department clerks or stenographers are often required who have a knowledge of one or more modern languages, natural sciences, or some experience in special lines of agriculture. Under present conditions it is very difficult to fill such positions from the registers of the Commission and special examinations are therefore necessary.

Delay in filling positions is often caused by the present inability of the Commission to certify suitable candidates from existing registers. While it is true that in some cases available candidates might be found in these registers whose general education and intelligence would enable them to satisfactorily fill the positions in this Department after a considerable period of training through the performance of the duties of their positions, it is obviously an expensive matter and a hindrance to the efficiency of the Department to be obliged to train its employees after their appointment and while they are on the salary roll of the Department. At least the necessity for such training should be reduced to a minimum.

#### DIVISION OF INSULAR STATIONS.

The general business connected with the management of the agricultural experiment stations in Alaska, Hawaii, and Porto Rico has been conducted during the past year in the Washington office through the division of insular experiment stations, of which Dr. Walter H. Evans is chief.

#### EXPERIMENT STATIONS IN ALASKA.

During the fiscal year ended June 30, 1903, experiment stations were maintained at Sitka, Kenai, and Rampart; a new station was established at Copper Center, and cooperative investigations were carried on at a number of localities. The experimental work for the greater part included the growing of cereals and vegetables, methods of reclaiming, draining, and fertilizing land, and the curing and ensiling of crops. The distribution of seed of hardy varieties of vegetables, cereals, and grasses has been continued and extended, seed having been distributed to more than a thousand addresses during the year. With these different lots of seed sent out, a request was included for a report upon the success of the different varieties. In this way much valuable information has been secured. An address list of about 1,500 names has been prepared, to which the publications of the station and other information are sent from time to time. The efforts that have been put forth in the distribution of seed by cooperation with this Department have already produced very beneficial results, as is shown by the constantly increasing number of gardens and other plats of ground which are brought under cultivation.

The supervision of voluntary observers of the Weather Bureau in Alaska has been continued as in former years. There are now 20 meteorological stations supplied with instruments by the Weather Bureau which report to the experiment station at Sitka. A detailed report of the operations of the Alaska experiment stations during 1902 was prepared by the special agent in charge and published as part of the annual report of this Office. The station staff, as now constituted, consists of C. C. Georgeson, special agent in charge; F. E. Rader, R. W. De Armond, and P. H. Ross, assistants at Sitka; H. P. Nielsen, superintendent in charge of station at Kenai, and J. W. Neal, who has been placed in charge of the recently established Copper Center station.

The new station which has been opened in Copper Center in the valley of the Copper River embraces a tract of about 775 acres selected previously by Messrs. Rader and Neal. This tract has been tempo-



rarily withdrawn from entry by the Secretary of the Interior and set aside for the use of this station. In establishing this station considerable difficulty was met with, owing to a lack of transportation between Valdez, the nearest port on Prince William Sound, and the interior. A start was made early in the spring to transport the equipment of the station over the military trail which leads from Valdez to Eagle. The team purchased for the use of the station was used for this purpose, but the task proved too difficult and transportation was completed by contract at a price that would be prohibitive to the ordinary individual.

During the past summer the special agent in charge of the Alaska stations visited the Copper Center station and has reported at some length upon the conditions as observed by him. About 10 acres of land have been cleared, plowed, and seeded to spring crops, which consisted chiefly of varieties of oats, barley, spring wheat, emmer, buckwheat, and various grasses. The season was rather backward and some of the cereals were not received in time for early sowing. Their growth was impeded by dry weather following seeding, yet on July 20 all were observed to be in a fairly flourishing condition. As noted in the previous reports, the newness of the ground had an important influence on the growth of the crops. Where brush had been burned or the ground previously cleared the growth was much better than elsewhere. The special agent believes that many of the cereals would mature by the end of August if frosts should not intervene. A fairly good garden was observed that had been planted by Mr. Neal, and peas, radishes, and lettuce were being supplied at the time of the visit of the special agent, and other hardy vegetables promised well. In addition to the ground seeded, 6 or 7 acres have been cleared and by next spring it is expected to have at least 20 acres under cultivation. The construction of a log house 14 by 28 feet has been begun and it was expected would be finished during the present summer.

At the Kenai station there are now about 15 acres under cultivation, and it is planned to clear and prepare for cultivation 10 acres additional. As previously reported, all hardy vegetables did well. Buckwheat, oats, and barley matured, but spring wheat was not fully matured during the past season. A one-and-one-half-story house has been constructed of hewn logs, which answers as a residence for the superintendent and for storage room for seeds, grains, etc. A stock barn has been constructed of lumber secured by the purchase of a cannery building, which was torn down, moved, and rebuilt upon the station farm. A beginning has been made at this station in animal industry, a cow and a calf having been added to the live stock equipment. A record was kept of the milk yielded by this cow during part of June, July, and August, and during a period of 87 days she gave 2,530 pounds of milk, or over 29 pounds per day. This production was made from a pasture of native grasses only and would indicate some of the possibilities of dairying on the Kenai Peninsula.

At the Rampart station, where work was begun in 1901, the investigations have been restricted on account of there being no one there to give his whole attention to the work. A small area of land has been cleared and seeded to spring wheat, barley, and oats, all of which matured finely. Winter rye, sown from seed matured in 1901, has again successfully passed through the winter and matured a crop

of fine grain. These results, attained at a latitude of  $65^{\circ} 30'$  N., aid in demonstrating some of the agricultural possibilities of the country.

The cooperative experiments conducted on Wood Island by the Rev. Curtis P. Coe, who is in charge of the Baptist orphanage at that place, have been conspicuously successful. Winter rye, spring wheat, barley, and oats were matured, and a good start has been made with various grasses and other forage plants. Hardy vegetables were produced in considerable quantity, and on the better tilled, older plats the yields were comparable with those obtained from latitudes much farther south. Mr. Coe says that he considers his year's work very successful. They raised about 250 bushels of potatoes, 100 bushels of turnips, 50 bushels of rutabagas, and carrots, parsnips, cabbage, cauliflower, onions, kale, and rhubarb in sufficient quantity to supply the 40 members of his family and to have considerable quantities for sale. Beginnings were made in animal industry under Mr. Coe's direction, the stock consisting of 4 cows, 3 calves, 5 Angora goats, more than 100 chickens, and about 25 ducks. Silos have been constructed to supply winter feed for the stock, but cattle have come through the winter in fairly good condition without any feeding except what they could obtain on the range.

At the Sitka station considerable work has been done in finishing the headquarters building and in enlarging the farm cottage, barn, and silos. The season of 1902 was an exceedingly wet one in southeastern Alaska, and great trouble was experienced in saving the ripened grain. Rain fell on 74 out of the 92 days of July, August, and September, and in order to save seed for the next season methods of drying were resorted to that would be impracticable where farming was carried on on a larger scale. As previously reported, all hardy vegetables did well in spite of the wet season. A beginning has been made to develop some work along horticultural lines. A small nursery has been established, and about 400 trees, mostly apple trees, are being grown to furnish scions for grafting. Several hundred currant, raspberry, and other shrubs are being grown and a start made with hardy ornamental shrubs, the object being to distribute the plants when their adaptability has been demonstrated. Potatoes in considerable quantity were planted in order to supply the numerous requests for seed potatoes for planting by natives and others who are away from available sources of supply.

#### PLANS FOR ALASKA STATIONS FOR 1904.

During 1904 efforts should be made to reopen and equip the station at Rampart. The work now being done at that place is in charge of Mr. J. W. Duncan, who has other duties and who can devote but little of his time to planting, cultivating, and caring for crops. The conditions at Rampart are representative of the largest body of agricultural land in Alaska, embracing many thousands of acres. The limited experiments thus far conducted at this station have shown the practicability of agriculture in this region, and there is need of a permanent superintendent to extend the work. Inquiries are coming in regarding the agricultural possibilities of the Yukon Valley, and the development of this Territory can be materially hastened by demonstrating on a farm scale the possibility of growing hardy grains, vegetables, etc. Buildings will have to be erected and an equipment of animals and implements purchased and sent to Rampart if it is

decided to reopen this station, but on account of its isolation freight rates, labor, and supplies are many times higher than in similar regions in the States. The limited resources devoted to Alaskan investigations will not permit of diverting much of the funds at present, and a larger amount than \$15,000 should be appropriated to carry on the work in a country as extensive and varied as Alaska.

At Copper Center, where operations have been begun this year, it is planned to clear as much land as possible and to grow grains and forage on a farm scale. Additional buildings and equipment are urgently required, but the same condition as explained above for the Rampart station applies here with equal force. Transportation is one of the most expensive items to be considered in relation to this station. It is reached over a trail from Valdez, but the trail is such a poor one that the team purchased for the station was rendered all but worthless by the hard work of carrying in the absolutely necessary articles for beginning the work. There is an urgent need for a good road constructed through this region along the line of the military trail. The special agent in charge estimates that there are about 10,000 square miles of good agricultural land in the Copper River Valley, with perhaps half as much more in the mountain valleys which lead out into the interior plain. The soil is rich and well adapted to cultivation, and it is believed feasible to grow good cereal crops at least three years out of four. Notwithstanding the rich mineral deposits of the Copper River country, it is believed that they will ultimately be greatly exceeded by the value of the agricultural products if this country is properly opened up.

At the Sitka station the headquarters building should be finished and provision made for some additional buildings. A small propagating house is desired for carrying on the horticultural investigations and inclosed chicken yards to carry out the investigations already begun with poultry. A large drying shed is needed as a shelter for crops which would otherwise spoil by exposure to the often heavy autumn rains. As the work progresses there is more demand for a scientific equipment at the Sitka station. There is need for a chemist, a botanist, and an entomologist, with the equipment along their various lines. For some time to come the necessary investigations of the different stations along the lines of chemistry, botany, etc., could be conducted at the Sitka station if the proper equipment were provided. There is now a headquarters station at Sitka, with branch stations at Kenai, Rampart, and Copper Center, all far distant from Sitka and in regions characteristic of considerable areas of the Territory. It is not believed desirable to establish any more branch stations, but to confine the investigations to those which can be carried on at the stations already established.

It is highly desirable that some work should be taken up with live stock. At present this can only be done in a limited way on account of the many demands upon the station funds. The special agent recommends the establishment of a temporary cattle ranch on Kadiak Island with a view of introducing some of the hardier breeds of cattle in Alaska. He believes that the Galloway breed is adapted to the conditions of that Territory, but that other breeds should also be tested for their adaptability. This investigation can not be carried on at any of the stations for a lack of sufficient natural pasturage in their immediate neighborhoods. Southwestern Alaska is a natural range



country, and Kadiak Island offers opportunities well adapted to this investigation. If an appropriation could be secured for the purchase and transportation of animals to this proposed reservation the special agent believes that the herd could be handled as a commercial enterprise, and would not only be self-sustaining from the start but could be made a source of considerable revenue to the stations. Congress has appropriated for a number of years for the introduction of reindeer to the more northern part of Alaska, and in a similar way provision might appropriately be made for cattle for the southwestern grass region.

#### HAWAII EXPERIMENT STATION.

During the fiscal year ended June 30, 1903, the work of the Hawaii Agricultural Experiment Station was in continuation of the various lines of investigation described in the previous reports with such special inquiries as occasion demanded. Additional portions of the station lands have been brought under cultivation and some experiments begun which will of necessity be continued for a number of years. The permanent improvements, such as buildings, fences, irrigation plant, etc., have been extended as occasion required and funds permitted. A new building was erected for the use of the agriculturist and entomologist, and the irrigation plant extended by the addition of about 2,000 feet of pipe, thus enabling a more extended application of water to the lower portions of the station grounds. A greenhouse covered with cheese cloth was erected and found well adapted to many uses. It is intended to make a trial of grapes, strawberries, and other crops under the partial shade furnished by such a covering.

A special effort is being made to build up a working library, and the special agent in charge has contributed his private collection of botanical and agricultural literature, amounting to about 2,000 books and periodicals, as a nucleus for the collection. Numerous additions have been made by purchase and otherwise to the library, and it is fast becoming a valuable asset of the station. A working library is indispensable to any institution, and where it is isolated from library facilities, as is this station, the necessity for its rapid extension justifies all that can be done for its increase, especially along economic lines. Provision has been made, as it will be noted elsewhere, for an office and library building, and it is believed that at least \$2,000 could be advantageously expended within the next year in extending the library.

During the past fiscal year the station has issued two bulletins in the regular series and five press bulletins, the latter being in the nature of emergency publications and somewhat less formal than those of the regular series of station publications. The bulletins issued were Bulletin 3, Insecticides for Use in Hawaii, by D. L. Van Dine, entomologist of the station, and Bulletin 4, The Cultivation of Sisal in Hawaii, by F. E. Conter, assistant at the station. The press bulletins published relate to the organization, object, and equipment of the station; the castor bean; preliminary experiments with potato diseases; a popular summary in the Hawaiian language of Bulletin 2 of the station on The Root Rot of Taro; and Manila hemp or abaca. The demand for station publications is increasing, and they are sought not only by residents of the Hawaiian Islands, but also by numerous individuals and institutions on the mainland. A card catalogue is kept of all addresses, and considerably more than 500 names are so indexed.

The experiments begun in the previous year on taro rot and potato rot have been continued upon an enlarged scale. The results already obtained have shown the practicability of combating one of the destructive diseases of taro by proper attention to the irrigation water and to the application of proper fertilizers. Although not yet ready for harvest, the present treated crop of taro shows marked superiority over adjoining untreated plots. The crop was planted with sound cuttings, but there was no application of lime and fertilizers aside from that given the previous crop. The results already obtained with taro will have an important bearing on the production of this important food crop.

The potato experiments on the island of Maui are being continued. In the previous report the varying resistance of certain varieties to the so-called black rot was pointed out, and experiments have been continued along this line. Unfortunately, seed tubers of one of the most resistant varieties could not be secured, and it was impossible to determine whether this variety would again prove able to withstand the attacks of the fungus which caused the total destruction of most of the 45 varieties tested. The effect of different methods of cultivation on the prevention of this disease has also been investigated. In former times potato growing was an important industry on Maui, but during the past ten years the disease has become so prevalent as to almost prohibit continued attempts in potato growing. The black rot, as it is called, although usually considered as a single disease, is in reality caused by two fungi. The true black rot may be combated by the thorough use of Bordeaux mixture, but the other disease, called "quick rot," is caused by a soil fungus that attacks plants through their roots and even causes whole fields to wilt and turn black within a few days. The organism causing this disease lives in the soil, and the common method of spraying plants can not be resorted to as preventive treatment. Experiments have been undertaken this year in which the seed tubers were soaked in a solution of formalin before being planted. The results obtained thus far seem to indicate the success of this method, as the plants grown from treated seed tubers were healthy and vigorous at the end of the fiscal year, while many others where no treatment had been adopted were killed. It is probable that by treating the seed tubers with a weak solution of formalin and planting them in an uninfested soil it would be possible to grow potatoes sufficient to supply the markets of the islands. These experiments and those with taro are to be continued for a number of years until definite results shall be obtained.

Formerly the growing of corn was an important industry on the island of Maui. At present the district is divided into large holdings, but the corn land is subdivided into small parcels and leased to Portuguese, Japanese, and Chinese tenants. Good cultivation of these lands by the tenants has been an exception rather than a rule. It is the practice to plow to a depth of from 1 to 3 inches, and what cultivation is given is by hand rather than machine labor. With this extremely shallow cultivation yields of 50 to 60 bushels per acre have been secured, but the seasons of 1901 and 1902 were so unfavorable to corn production that many of the areas were allowed to revert to grass lands. In addition to the unfavorable seasons, the corn has been badly affected with an aphid, which increased in such numbers that at the time the corn should be filling the leaves of the plants were

brown and shriveled. It was thought possible to improve the condition by stimulating a better growth of plants. Arrangements were made by which 10 acres of land were secured and planted to a number of the best varieties of corn from the Middle West and the New England States. The soil was plowed to a depth of 6 inches to a foot, and manure and fertilizers applied to the different varieties planted and thorough cultivation given the crop during the growing season. The use of catch crops was also investigated and the experiment is to be continued through a term of years. At the present time the corn planted on land which had been well manured and the corn planted in deep furrows are in excellent condition, while that planted in the usual way is of but little account. Two varieties, Leaming and Boone County White, show a much more favorable growth than any of the others or than the so-called native varieties, seeming to indicate that these varieties are particularly adapted to cultivation in Hawaii.

A series of variety tests with tomatoes has been begun by the agriculturist. A collection of 145 varieties was secured from seedsmen from various parts of the world, and not only are they being tested for their adaptability, but the effects of different methods of culture, fertilizing, training, etc., are being investigated. Difficulties have been encountered in growing tomatoes in Hawaii to secure fruit of good size and color and plants which were resistant to diseases and insects. It is hoped that this series of experiments will disclose some varieties and methods of culture adapted to Hawaiian conditions.

The agriculturist visited Kauai, the most northern and geologically the oldest of the islands of the group. He found the soil deep, rich, and well watered, there being three important streams on the island. As on the other islands of the group, the rainfall is principally on one side of the island. The agricultural and horticultural conditions observed are reported upon, the details of which will be given in the forthcoming report from this station. Considerable attention seems to have been given on this island to forestry, and a number of thriving plantations were observed. The ranchers on the island are giving considerable attention to the growing of forage crops and to more rational methods of stock feeding than those hitherto employed. The station should cooperate in these enterprises, and is doing so as far as its resources will permit. The Hawaiian Live Stock Breeders' Association has become interested in the station and its work and was instrumental to a considerable degree in securing the assistance given the station by the recent legislature. The subject of animal husbandry will have to be taken up by the station, and this will entail not only the expense of an additional member of the station staff, but the equipment of buildings, live stock, etc., which the station as now organized can ill afford.

A collection is being made of the grasses and forage plants of the islands, and it is hoped that a bulletin can soon be issued concerning them. This will contain notes on the native and introduced species, with suggestions relative to their value for different purposes.

The entomologist has been engaged during the past year upon a general warfare against all sorts of injurious insects. The alligator pears in a portion of the islands were threatened with destruction by a mealy bug, but by energetic work in pruning and spraying the trees were saved. Attention is being given the Japanese rose beetle, the melon fly, poku or cutworms, cane borers, and other insects which are



especially injurious. During the past year a serious outbreak of leaf hoppers was reported in the cane fields of Hawaii, and at the request of some of the planters the entomologist spent several weeks studying the pest in the hopes of finding some method of combating them that would do away with the tedious delay and consequent loss attending the introduction of predatory insects.

The assistant agriculturist of the station has been devoting his attention very largely to the subject of fiber plants, and has prepared a bulletin on the sisal hemp in Hawaii, as well as a press bulletin on Manila hemp or abaca. There have been many inquiries regarding fiber-producing plants and there was a demand for information on the planting and management of sisal plantations. There are extensive areas in these islands which are adapted to sisal growing, and the experiments thus far carried out show the practicability and profit of the industry.

Experiments have been begun and plantations commenced of vanilla and cacao. These will be continued and extended as opportunity presents itself. Some investigations have been inaugurated in growing cotton and tobacco. The experiments with tobacco, especially with Sumatra leaf tobacco, grown under the partial shade furnished by light cloth, have been apparently very successful, and will be continued upon a larger scale. The quality of the product is yet to be tested, but it is believed there are a number of localities in the island where Sumatra tobacco can be grown under shade at a decided profit.

The different members of the station staff have from time to time visited the different islands, at least a dozen such trips having been made during the past year in which specific problems were investigated and advice given concerning various topics. Some of these visits were in connection with the farmers' institutes, the first of which was held under the auspices of the station in January, 1902. These have been continued and have become quite a feature of the station work. Meetings have been held in a number of localities, and the interest and attention has been constantly on the increase. A permanent organization has been effected, and the power of the farmers' institute as a factor in the education and elevation of the Hawaiian farmer has been recognized by a specific act of the recent legislature making an appropriation for continuing and extending the work.

The legislature of Hawaii at its recent session appropriated \$16,800 toward the support of the station for the biennial period ending June 30, 1905. This is to be expended under the general supervision of the Territorial board of agriculture and is apportioned as follows: Maintenance, \$10,000; salary of chemist, \$2,000; library and office building, \$3,000; residence for chemist, \$1,500; stenographer, \$600; and farmers' institutes, \$300. The appropriation for maintenance can not be used for the payment of salaries, but will have to be used in work of a scientific character, and it is proposed to devote a considerable portion of this fund to experiments with tobacco, vanilla, cotton, and cacao, and the investigation of problems in connection with the feeding of animals.

The station staff at the end of the fiscal year consisted of Mr. Jared G. Smith, special agent in charge; T. F. Sedgwick, agriculturist; F. E. Conter, assistant; and D. L. Van Dine, entomologist. Since the beginning of the present fiscal year Mr. Sedgwick has resigned to

take a position in Peru at a largely increased salary, and Mr. Edmund C. Shorey has been appointed chemist to the station.

#### PLANS FOR HAWAII STATION FOR 1904.

The several lines of investigation described above will be continued during the year and new investigations taken up as opportunity offers. The building of a small insectary is contemplated to enable the entomologist to prosecute his studies on the life history of some of the troublesome insects which prey upon the various agricultural and horticultural plants in Hawaii. It is intended to make a thorough trial of tobacco growing under shade to see if it can be made commercially profitable. On account of the assistance given by the Territory it is possible for the station to have a chemist, and Dr. Shorey has been appointed to fill that place. It is expected that in addition to other matters he will take up a study of the soils of Hawaii and the use of fertilizers so as to supplement the field work of the agriculturist and other members of the station staff. Special efforts will be put forth to secure improved varieties of tropical fruits and other products for introduction into Hawaii. There are doubtless better varieties of bananas, pineapples, vanilla, cacao, etc., than those now grown in Hawaii, and persistent efforts should be made to secure them. The work on forage plants will be prosecuted and some investigations begun on the rational feeding of animals.

#### PORTO RICO EXPERIMENT STATION.

Since the last report upon the Porto Rico Experiment Station a permanent site has been secured adjoining the city of Mayaguez, located upon the western end of the island. As mentioned in the report for 1902 this tract was purchased by the insular government for the use of the station, and although possession was secured a few days before the end of the previous fiscal year the removal of the station from its temporary location at Rio Piedras was not effected until some time later. The station farm embraces 235 acres of land of varied character, topography, and exposure. A number of buildings in various stages of repair were on the farm at the time of its transfer. These have been repaired and put in condition for use by the station. The farm had not been under close cultivation for a number of years and had to a considerable extent grown up with weeds, shrubs, etc. The work of putting the farm into order was continued during the early weeks of the present year, and consisted chiefly in the repairing and painting of the buildings, repairing of roads, and construction of culverts, together with the building of fences, cleaning of ditches, and a small amount of ornamentation of the grounds.

During the early part of the fiscal year about 15 acres of land were cleared of brush and weeds, plowed, and planted to general crops, in order to bring the soil into condition for experimental purposes. The crops planted were chiefly corn, beans, rice, Kafir corn, and alfalfa, all of which were harvested in February, March, and April, except the alfalfa. By reason of insect pests, fungous diseases, and a long period of drought the crops were very meager, in most cases little more than the seed sown being secured. The alfalfa continued to grow, producing a good root development, although the amount of

forage was quite small. So far as observed no tubercles were found upon the roots, and it is probable that inoculation of the soil will be necessary before alfalfa growing can be made a success. Since the harvesting of the crops the land has been laid out in permanent tenth-hectare plats, and a considerable portion of it is now planted to experimental crops. The general preparation and planting was not commenced until after the beginning of the rainy season, which this year was about May 20. From January 1 to May 20 less than 0.05 inch of rainfall per day was measured, while for the last ten days of May it averaged a little more than an inch per day, and the first ten days of June were equally as wet.

Attempts have been made to establish various nurseries, and these were planted during the entire season as material was available. Among the nursery plants seedlings of all of the varieties of citrous fruits which were obtainable on the island have been planted and will soon be large enough for budding. A considerable number of tropical plants were secured through the Department at Washington, all of which were placed in the nursery, but some have since been set out in permanent plantations. Among the tropical plants received were 100 rubber seedlings, 200 tea seedlings, and smaller numbers of figs, pistachio, etc. Many native varieties of fruits, such as mangoes, alligator pears, mammee apples, and others have been collected for propagation.

In another portion of the farm an experimental banana plantation was started in December and January, and now contains 42 different varieties of bananas, 20 of which were secured from Jamaica, the remainder collected from different parts of the island of Porto Rico. A cacao grove has been started and now contains 13 varieties, while on a prominent clay ridge in the eastern part of the farm a forest plantation has been begun and several hundred trees have already been planted. These not only represent trees obtained in Porto Rico, but many that were secured from other West Indian islands as well as through agents of the Department of Agriculture in various parts of the world.

Arrangements have been made by which plants of economic value are obtained for the station from Jamaica through the botanic garden at Kingston and from other portions of the West Indies through the British commissioner of agriculture for the West Indies. Through these different sources a considerable number of tropical products have already been collected, among them a large number of varieties of cassava, yams, yautia, and the malanga. A test of fiber plants has been commenced, and there is now growing at the station the Manila hemp from the Philippines and sisal hemp from the Bahamas, together with a number of species of fiber plants which occur upon the island.

Experiments have been continued with vegetables from northern-grown seeds, but as yet they are not sufficiently advanced to show what the probable outcome will be. In many instances the results obtained are very discouraging from the standpoint of cultivation of northern vegetables. Where barnyard manure or commercial fertilizers have been applied the crops are doing their best, but, even with the best care and heavy application of fertilizers, beans, sweet corn, and cucumbers are doing very poorly. The trouble seems to be a combination of a lack of adaptation, together with serious depredations of insect and fungous enemies.



As referred to in the previous report, investigations in restoring the fertility of the soil are being conducted and experiments are now under way testing fertilizers for such crops as bananas, yautia, forage crops, and vegetables. The value of leguminous crops for restoring soil is under investigation, and velvet beans, soy beans, beggarweed, and two varieties of Egyptian alfalfa are being tested. Of these the velvet beans and soy beans are the most promising, being far superior to cowpeas, which are here very much troubled by a small leaf hopper and a stalk borer.

Experiments with coffee have been carried on throughout the year in accordance with the plans given in the previous report. The results of the application of fertilizers to the nursery bed were quite noticeable, and the expert in charge reports that bat guano secured from caves on the island has shown better results than those secured for any of the commercial fertilizers. The seedlings are now of a good size and ready to transfer to the plantations, and arrangements have been made whereby a number of planters will be given sufficient trees to plant one-half acre. These are to be planted and cared for according to the directions prescribed by the experiment station. Many trees will be planted on the coffee experiment plats at La Carmelita. On this estate 10 acres which were turned over to the station have been laid out and treated in different ways. The tract was thoroughly cleaned of weeds and undergrowth and different methods of cultivation, pruning, and shading are under investigation.

During the early part of the fiscal year the botanist of the station made a visit to the northeastern part of the island, and reported on the boundaries of public lands in the Luquillo district. This region embraced the principal portion of native forest remaining on the island, and the survey was made to establish the boundaries for a forest reservation. Based upon the report submitted, a forest reservation of about 25,000 acres was proclaimed by the President in January, 1903.

During the latter portion of this year Prof. F. S. Earle, of the New York Botanic Gardens, as a temporary agent of this Office, visited the island to make a study of some of its horticultural possibilities and make observation upon some of the diseases of economic plants. The time at his disposal was so short that a thorough survey could not be made, but the report shows that the horticultural possibilities of Porto Rico are very promising. The principal drawbacks to the rapid horticultural development of the island are lack of transportation on the island and between Porto Rico and the mainland markets. Bananas and pineapples were observed to be in a very flourishing condition, and many orange plantations have been set out during the past few years, so that within the near future a successful orange industry is believed to be promising. Few insect pests or diseases were observed which are not known to occur elsewhere, and many of the insects are held in check by their natural parasites. Professor Earle's report will be published in full in the Annual Report of the Office of Experiment Stations.

The botanist and entomologist has continued the collection of the plants and economic insects of the island, but has not been able to make much progress in extending the collections, as a very great portion of his time has been occupied the past year with horticultural work, which seemed of more immediate importance.

Numerous additions, both of bound publications and pamphlets, have been added to the library, and a card catalogue is contemplated, by which the different subjects will be brought together in a way to render the resources of the library more readily accessible. Exchanges have been effected with a number of publications, and special efforts are put forth to secure publications relating to tropical agriculture in various parts of the world. A mailing list of about 800 addresses has been prepared, most of which are in Porto Rico.

Since the publication of the last report of this station two bulletins have been issued in both Spanish and English editions. The first, which is entitled *The Agricultural Experiment Station of Porto Rico*, gives an account of its establishment, location, and purpose; while the second is devoted to the changa or mole cricket, one of the most serious pests to Porto Rican agriculture and horticulture. The manuscript relating to the soil survey, which was described in the previous report of this station, has been prepared and will probably be issued as Bulletin No. 3 of this station.

The present organization of the station staff in addition to F. D. Gardner, special agent in charge, is O. W. Barrett, entomologist and botanist; J. W. Van Leenhoff, coffee expert; E. C. Howe, clerk and stenographer; and E. G. Bowersox, who is temporarily serving in the capacity of farm foreman.

#### PLANS FOR PORTO RICO STATION FOR 1904.

The appropriation for the station in Porto Rico has been increased to \$15,000, the station now receiving from the National Treasury the same financial aid as that given to the States and Territories. In addition to this, the insular government appropriated \$2,700 for permanent improvements and special investigations. The work as outlined for the previous year will be continued during the present year, and extensions will be made in as many instances as possible. It is expected that new varieties will be added to the banana, cacao, and citrous fruit plantations, and the fertilizer experiments will be extended to additional crops and to the use of different kinds of manures. Land is now being prepared for a pineapple plantation, and as soon as the plants can be secured the best obtainable varieties will be planted. Arrangements are being perfected for planting 24 varieties of improved and budded oranges, lemons, and grape fruit. Investigations will be inaugurated in farm drainage. Drainage pipes or tiles are very expensive in Porto Rico on account of the cost of transportation from the States, but negotiations are in progress for the purchase of a small-sized tile machine, and the tiles can be manufactured on the station.

Tobacco investigation has been begun, but, owing to the small appropriation, it can not be more than a preliminary survey. It is possible that the preliminary work being done will result in a plan of cooperation with some prominent tobacco growers, enabling the station to secure the services of a specialist to continue the work in growing, fermenting, and manufacturing tobacco.

The soil survey of the island should be continued, but at present the station can not undertake this on any enlarged scale, as it has not sufficient funds to prosecute the investigation, and the present wording of the law providing for the Bureau of Soils of the Department of Agriculture does not permit of the expenditure of funds in these investigations outside of the continental portion of the United States.

The coffee experiments will be continued along the lines already mapped out. Cooperative experiments with representative planters in different parts of the island will be conducted in planting seedling coffee trees that have been grown at the experiment station from selected seeds, the seedlings having first been sheltered by artificial shade, which was later gradually reduced until the plants are now growing in full sunlight. These are to be planted according to directions given by the station to test the relative efficiency of growing coffee with and without shade.

The most important lines of work for the station seem to be at present along horticultural investigations, and it is exceedingly important that a man well trained in the principles and practices of tropical horticulture be secured for this position. At present there is a greater demand for the practical business and commercial aspects of this work than for the scientific, as commercial orcharding has never been established on the island. Those who have investigated the subject believe in the possibilities of commercial horticulture, and a number have already embarked in the business; but there are many questions to be studied which naturally pertain to the investigations of the station rather than to the trials of the individual grower.

Porto Rico is an extensive stock-growing country, annually shipping thousands of head of cattle to Cuba, and this industry, together with the dairying industry, should warrant more attention than it has been found possible to give it. There is a considerable demand for investigations along various lines in animal industry, but the present funds of the station will not admit of the employment of an expert in this line, nor of the purchase of animals and the general expense of feeding. Some investigations can possibly be inaugurated in a limited way, but at present prominence can not be given to them.

For some time to come there will be much work to be done upon the station farm in the construction of buildings, roads, fences, ornamental planting, etc., all of which will have more or less permanent value in demonstrating the necessity for such improvements.

The cordial support which has thus far been accorded the station by the insular legislature, together with the interest manifested by planters in requesting its publications and in soliciting specific information, is very encouraging and bespeaks for the station a high degree of usefulness. It is confidently believed that the people of Porto Rico will assist the station by adequate appropriations, so that its usefulness may be enlarged from year to year.

#### NUTRITION INVESTIGATIONS.

During the fiscal year ending June 30, 1903, the inquiry regarding the food and nutrition of man, conducted under the auspices of this Office, has been continued along the same general lines as hitherto. There was no increase in the appropriation granted by Congress (\$20,000), and it has been impracticable to extend the work in some directions, as was desired; but for the amount expended large results have been obtained.

As in former years, a considerable portion of the amount appropriated has been divided among various educational, scientific, and similar institutions throughout the United States, the sum allotted serving more as an encouragement to research than as actual compensation for



the work done. These cooperating institutions have thus been made centers of scientific research in this particular line of investigation and have in most cases contributed largely in laboratories, apparatus, libraries, the counsel and assistance of experts, and similar gratuitous service. By this method of cooperation the amount appropriated has been expended more economically and yielded larger returns, a greater variety of questions has been studied under different local conditions, a more widespread interest in the investigations has been aroused, a corps of skilled investigators throughout the country has been trained for the carrying out of such inquiry, and the results obtained have been made more extensively available.

The nutrition investigations are devoted mainly to the study of the physiological, hygienic, and economic branches of the subject. The chemical work is confined chiefly to determinations of the composition of different food materials and excretory products involved in the experimental inquiries, and is only preliminary to the study of the physiological branch of the subject, the principal object of the inquiry being to discover the fundamental laws of nutrition and their economic and sociological application to the food of man.

To this end four general classes of investigations have been carried out: (1) Dietary studies; (2) digestion experiments; (3) cooking experiments; and, (4) metabolism experiments.

The *dietary studies* have been made in several widely different localities and have included the study of the diet of people varying in occupation, age, sex, and circumstances. Their purpose has been to procure data in regard to the kinds, amounts, and costs of food materials under different conditions, to give opportunity for comparison with the data obtained by investigators in other countries, and to assist in establishing a general dietary standard.

The *digestion experiments* have also been carried on in different parts of the United States under varying conditions. These experiments have been made in order to obtain data with reference to the digestibility of various classes of food materials, the amount of the material consumed which is made available to the body, and the establishment of standards. Meats, legumes, cereals, fruits, and nuts have been the especial subjects of experiments the past year. The digestion experiments with meat have included the study of the influence of cooking, as well as of age and breed of animal, etc., upon the digestibility. The digestion experiments with cereals have included the study of the effect of different methods of the milling of flour upon the digestibility of bread made from it.

The *cooking experiments* have been made only with meat, and have included the study of the effects of cooking upon the flavor, palatability, and digestibility of the meat, beef being usually used for the purpose.

The *metabolism experiments* have been of two general sorts: (1) Those in which the income and outgo of nitrogen was studied, and (2) those which took account of the income and outgo of nitrogen, carbon, and energy. The former have been made in connection with all the digestion experiments. The latter have been made only at Middletown, as they necessitate the use of the respiration calorimeter.

In connection with all investigations some analytical work, both physical and chemical, was, of course, necessary for the successful carrying out of the experiments. The development of apparatus and

methods has received much attention the past year, especially at Middletown. A large amount of editorial work, including calculations and the verification of data, has also been required at both Washington and Middletown to prepare the results of the investigations for publication in both technical and popular form.

Cooperative investigations have been made during the past year at the following institutions:

*California:* University of California, Prof. M. E. Jaffa and associates.

*Connecticut:* Wesleyan University, Carnegie Institution, and Storrs Experiment Station, Prof. W. O. Atwater and associates.

*District of Columbia:* Department of Interior, Government Hospital for the Insane.

*Georgia:* University of Georgia, President H. C. White and associates.

*Illinois:* University of Illinois, Prof. H. S. Grindley and associates.

*Maine:* University of Maine, Prof. C. D. Woods and associates.

*Minnesota:* University of Minnesota, Prof. Harry Snyder and associates.

*Tennessee:* University of Tennessee, Prof. C. E. Wait and associates.

#### WORK AT THE WASHINGTON OFFICE.

The Washington office, in addition to editorial work, has had a general supervision of the plans and expenditures of the nutrition investigations during the past year. The results of such inquiry in this country and in Europe not generally available and bibliographical data have been collected, and the current literature on the subject of nutrition has been reviewed and abstracts made, partly for use in the Experiment Station Record and partly for such other purposes in connection with the general inquiry as seemed desirable. A special effort has been made to secure data regarding the dietary conditions in the Tropics, and material has been collected, some of it original matter. The growing interest in the nutrition investigations carried on under the auspices of the Department is indicated by the constant increase of correspondence in this connection. This correspondence, and also the distribution of the nutrition publications, is attended to at the Washington office.

#### THE COOPERATIVE INVESTIGATIONS.

In connection with the cooperative nutrition investigations for the past year a number of questions have been studied, in a majority of cases the work being a continuation of that already undertaken. The general purpose was to complete certain lines of work and then undertake the study of other problems.

In the following the different investigations are discussed in some detail:

##### CALIFORNIA.

The nutrition investigations at the University of California, conducted by Prof. M. E. Jaffa and his associates, were a continuation and completion of the work begun in 1901-2. The work of the two years should therefore be considered together. That in 1902-3 was carried out at Middletown, Conn., where Professor Jaffa has been studying the past year on leave of absence from the university. The investigations of the two years were as follows:

Thirty digestion experiments, including the income and outgo of nitrogen, conducted during 1901-2 with subjects whose food consisted of fruits and nuts only or largely, as well as seven dietary studies with

fruitarians, and a number of analyses of samples of food materials and excretory products. Of these, the digestion experiments and dietary studies, together with 205 analyses of food materials and excretory products, were made in California. In Middletown 75 complete chemical analyses of excretory products and the determination of 160 heats of combustion of food materials and excretory products were made under Professor Jaffa's direction and the results calculated.

Professor Jaffa has also written a complete report of the two years' work, at the same time compiling and collating much useful material on the nutritive value of fruits and nuts to round out his report and make it more complete. The result forms a publication of much interest, particularly in view of the fact that comparatively little attention has been paid to this subject, which is of especial importance to the people of California, as fruits and nuts form so large a part of the agricultural products of the State.

#### CONNECTICUT.

The work at Middletown, Conn., under Prof. W. O. Atwater, chief of the nutrition investigations, has included the planning and direct supervision of the cooperative investigations throughout the country; improvements in apparatus and methods; the carrying out of special inquiries with the bomb and respiration calorimeters; such analytical work as was necessary in connection with the investigations; editorial work in preparing the results of the inquiries for publication; the compilation of results of investigation in this and other countries on the food and nutrition of man; correspondence and general administrative work.

In addition to the amount set aside for work at Middletown under the auspices of the Department, the legislature of Connecticut has appropriated each year \$1,800 to the Storrs Experiment Station for nutrition investigations which are carried out at Wesleyan University under Professor Atwater's supervision. Wesleyan University also contributes the use of its laboratories and other facilities for the same purpose. The Carnegie Institution of Washington has granted Professor Atwater the sum of \$5,000 for the year beginning November 1, 1902, to assist in devising apparatus and methods for the direct determination of oxygen in connection with the respiration calorimeter.

The work with the respiration calorimeter, which is under the more immediate supervision of Prof. F. G. Benedict, has been largely devoted to the modification and improvement of the apparatus, with such experimental work as was required to test its accuracy. In its modified form, the ventilation air current is in a "closed circuit;" that is, the same air is used over and over again. The water and carbon dioxid imparted to the air by the subject are constantly removed by passing the current through sulphuric acid and through soda lime; oxygen is then added to replace that used by the man under experiment. This arrangement permits the more accurate determination of carbon dioxid and water and, a still more important feature, the direct determination of oxygen, which has been made possible by the changes in the apparatus made under the Carnegie grant.

A number of electrical check experiments were made to test the efficiency of the modified calorimeter for measuring heat. Certain discrepancies which have appeared in former years were sought out and eliminated. The final and most crucial check experiment was the com-



bustion of alcohol in a specially devised lamp, provided with an arrangement for maintaining a proper level and measurement of the amount of alcohol used without moving the lamp from the calorimeter. Each alcohol check experiment was followed by a longer or shorter period of experimentation for the purpose of correcting errors and refining manipulation.

The culminating feature of the year's work in this especial line was the conduct of two respiration experiments, each of three days, with a man at work on a stationary bicycle. In the first a diet containing a large amount of fat was used, while in the second a carbohydrate diet was supplied, the purpose being to compare the relative efficiency of fats and carbohydrates as sources of energy for muscular work. These work experiments were in continuation of those of previous years, with the valuable additions of the determination of the amount of oxygen consumed and the respiratory quotient. In so far as these experiments were similar to those of other years, they pertain to the investigations of this Department; but the determinations of the balance of income and outgo of oxygen and the respiratory quotient, and the apparatus and method for making these determinations, pertain to the work done in cooperation with the Carnegie Institution.

Previous to the work experiments two rest experiments of a little over one day each were made with different subjects. These were not complete in all details and are regarded as distinctly preliminary experiments.

**OTHER EXPERIMENTAL WORK.**—In connection with the Wesleyan University Summer School, held at Middletown last July and mentioned in last year's report as being in session, a dietary study was made in a boarding club, the results of which will be published with those of other studies.

A series of digestion experiments has just been begun for the purpose of studying the digestibility and nutritive value of different cereal products, i. e., breakfast foods. In view of the important place which cereals hold among farm crops and as articles of diet, it is hoped that a more extensive study of the subject may be made the coming year.

The nutrition investigations carried on at Middletown for the Storrs Agricultural Experiment Station have included studies of the chemical composition of poultry. In these the Department has cooperated in the determination of the energy values of the samples.

Determinations of heats of combustion of samples of food materials from dietary studies carried on in Vermont, referred to in last year's report, were made at Middletown during the past year, as the Vermont station has no facilities for work of this character.

Improvements have been made in the bomb calorimeter, which is used in the nutrition investigations for the determination of heats of combustion, and also in the method of its use. An article has recently been prepared by Professor Atwater and Dr. J. F. Snell, the latter formerly an assistant at Middletown, describing the apparatus and the method of using it, which has been published in the *Journal of the American Chemical Society*.

As previously stated, a large amount of editorial work is carried on at Middletown, including calculations, verifications of results obtained in the cooperative investigations, the collating of results of other investigations, and the preparation for publication of the results of the experimental work at Middletown and at cooperating institutions.

Under Professor Atwater's direction, Prof. Kintaro Oshima, now of the University of Sapporo, Japan, has made a compilation of Japanese nutrition investigations which promises to form a very interesting publication. Professor Oshima was well fitted by education and training to do this work, as his specialty is physiological chemistry. Professor Oshima has returned to Japan, but hopes to have the opportunity of making investigations in that country with reference to the amounts of nutrients and energy of food and especially the amounts of protein required for severe muscular work.

The Wesleyan University Summer School last summer was a decided success and was attended by many of the leading domestic science teachers in schools and colleges throughout the country. The results of the nutrition investigations carried on at Middletown and at cooperating institutions were made use of in the courses of instruction and the methods of carrying on dietary studies, digestion experiments, and of making food analysis were explained and illustrated. A great deal of interest was shown by the students, and there has been a general request made that the sessions of the school be continued.

#### DISTRICT OF COLUMBIA.

In cooperation with the Department of the Interior some very interesting dietary studies have been carried out in the Government Hospital for the Insane, Washington, D. C. These investigations were inaugurated at the desire of the late Dr. A. B. Richardson, superintendent of the Government hospital, as a part of his general plan for maintaining a high standard for the conditions under which the patients and employees lived in this great institution. By reason of his intelligent appreciation of the requirements of such work satisfactory arrangements were made for its prosecution. The studies were under the direct charge of H. A. Pratt, who had previously assisted in such investigations at the Elmira Reformatory, Elmira, N. Y., and elsewhere in connection with similar studies made under Professor Atwater's direction.

Twenty-six dietary studies were made in all, with about 1,600 male patients and 125 dietary employees. The results of these studies have been edited and are nearly ready for publication. Investigation has shown that in general the food of the Government hospital is wholesome in quality and adequate in amount. In many cases it was found that the waste was excessive. Steps were immediately taken to check the waste, and as a result the cost of the food for the year was considerably lowered without affecting in any way the quality or amount. A consideration of the details of the studies suggests numerous ways in which the results can be further applied. For instance, it would undoubtedly add to the attractiveness of the diet to have a fortnightly rotation of menus rather than a weekly rotation, as is a common custom where large numbers are fed under uniform conditions. In some instances it would unquestionably be possible to suit the foods more nearly to the demands of individuals or groups. It is gratifying to note that so far as can be judged by a comparison of the results obtained at the Government hospital with similar data secured elsewhere this institution seems second to none as regards the diet of the patients. It would be readily possible to so improve this department that it might serve as a model for all similar institutions in the United States.

## GEORGIA.

The nutrition investigations at the University of Georgia, under the direction of President H. C. White, included the study of the dietaries of typical families of white people of limited means in the mountain districts of the State, and one of a negro laborer's family. The studies were made carefully, but under great difficulties, on account of the inaccessibility of the localities and the difficulty of securing the cooperation of the people. Dietary studies of this character are of especial interest and value in themselves and for purposes of comparison.

In all, 10 dietary studies were made and 55 analyses of food materials and wastes. The results obtained show a very simple diet. The articles of food are few and the methods of preparation primitive. It is the purpose to include in the report of these studies considerable sociological data, and use the results, in connection with those of similar studies in Tennessee and elsewhere, in a discussion of the productive capacity of these people as regards useful labor, in relation to their diet.

## ILLINOIS.

Professor Grindley has continued his valuable work with meats at the University of Illinois the past year. This included the carrying out of 20 digestion and nitrogen metabolism experiments with men, in which meat (beef) formed the chief part of the diet; 65 artificial digestion experiments with different kinds of meat to determine the influence of cooking upon the digestibility; 47 cooking experiments with meats to determine the losses in cooking and its influence upon flavor, palatability, digestibility, etc. In connection with these experiments, Professor Grindley made the analyses of 174 samples of food materials and excretory products and the determination of 130 heats of combustion.

In addition to his experimental work, Professor Grindley has prepared a bulletin on the cooking of meats, which gives the results of his investigations in this direction.

Professor Grindley's investigations on the losses occurring in the cooking of meats appear to show that boiling causes a greater loss of water than other methods of cooking. Some nitrogen and mineral matters were found in the resulting broth. The amount of fat in the broth depended somewhat upon the amount of fat in the meat, but more especially upon the nature of the meat used for the experiment. Different cuts of meat produced a noticeable difference in the amount of fat in the broth, the amount varying according to the character of the cut. The amount of loss depended upon the time of cooking, and was inversely proportional to the size of the piece of meat. In pan boiling the losses appeared to be unimportant. There was a considerable loss of weight, mostly caused by a loss of water. A gain of fat was noted, owing to absorption of the fat used in the process.

## MAINE.

The chief studies undertaken at the University of Maine, under the direction of Prof. C. D. Woods, were those carried out in logging camps, with men doing large amounts of muscular work under severe conditions of cold and exposure. Six digestion experiments of six days each with wood choppers were made with the analysis of the food materials and excretory products. Two dietary studies were also con-



ducted with crews in logging camps, analyses being made of the foods used.

The dietary studies showed that the lumbermen who performed very large amounts of work ate correspondingly large amounts, the diet being high in both protein and energy.

In addition to the above, some preliminary work was done during the year with regard to methods for the determination of phosphoric acid, potash, and sulphur by means of the bomb calorimeter.

#### MINNESOTA.

At the University of Minnesota, Prof. Harry Snyder has continued his investigations regarding the nutritive value of flour milled in different ways when made into bread. The inquiry has been especially satisfactory this year, as the experimental mill of laboratory size, purchased last year, has made it possible to secure uniform grades of flour for use in the investigations.

In the first series of experiments, Oklahoma and Oregon wheats were used. From each sample three grades of flour were milled—graham, entire wheat, and “straight” grade—six separate samples of flour in all. Three digestion experiments with men were carried out, in which bread made from each lot of flour was used. A total of 18 digestion experiments of four days’ duration each were conducted. Complete analyses were made of 20 samples of the original wheat, flours, and other food materials, and of 90 samples of excretory products. The results of these experiments confirm the former work done along this line, and are still more conclusive.

The second series of experiments included 3 digestion experiments with men, in which bread was used made from straight-grade flour to which 7 per cent of fine ground germ was added; and 3 digestion experiments with men using bread made from straight-grade flour to which 15 per cent of fine ground bran was added, the proportion of germ and bran being about the same as is ordinarily removed in milling. The special purpose of these experiments was to determine whether either bran or germ alone, in a fine state of division, added any nutritive value to the flour used for the bread. It was found that the finest granulation of the bran and germ resulted in a slight increase of digestibility over graham and entire-wheat flours, but that the total available nutrients in the bran and germ flours were no larger than in straight-grade flour. In carrying out these latter experiments, 30 analyses were made of the bran, germ, bread, milk, and excretory products.

#### TENNESSEE.

Professor Wait, at the University of Tennessee, Knoxville, has continued his investigations along the same lines as heretofore, two kinds of work being undertaken, namely, dietary studies with white people of limited means in the mountain districts, and digestion experiments for the purpose of studying the digestibility of legumes. In connection with the latter, the income and outgo of nitrogen has been determined. The dietary studies have been carried out under unfavorable conditions, but the results are of especial interest. Prof. A. F. Gilman has been in immediate charge of the studies under Professor Wait’s direction. In all 20 dietary studies were made, including the analysis of 20 samples of waste products.

Twelve digestion experiments were also made with men, 6 being basal ration experiments, followed by 6 experiments in which legumes were substituted for a certain proportion of the ration used in the previous experiments. In connection with these digestion experiments, Professor Wait made 39 analyses of wastes, food materials, and excretory products and 33 determinations of the heat of combustion of food materials and excretory products.

The results of the dietary studies were very similar to those with people of the same class in Georgia, showing a simple diet of few food materials, with primitive methods of preparation. The digestion experiments were made in such a manner that the digestibility of the legumes could be calculated, and the figures thus obtained indicate that the digestibility of the protein and carbohydrates of the legumes studied was comparatively high.

#### MISCELLANEOUS COOPERATION.

In addition to the regular cooperative investigations, assistance has been rendered to several institutions and individuals. By acting in an advisory capacity, the results of the general inquiry have been made of immediate practical use to the teachers of domestic science in various schools and colleges. In this connection, it may be noted that a dietary study has been carried out the past year at the University of Missouri, for which dietary schedules were furnished and suggestions given as to the method of conducting the work.

The work on bone and other animal proteids, referred to in last year's report, has been continued and will doubtless be completed in the early autumn. This work has been carried on in cooperation with Prof. W. J. Gies, of the College of Physicians and Surgeons, New York City, and was begun at his request. The results will, it is hoped, be valuable for purposes of comparison.

By the request of Prof. T. B. Osborne, of Sheffield Scientific School, Yale University, and chemist at the Connecticut Agricultural Experiment Station, cooperative work of a similar nature is being undertaken with vegetable proteids.

Both of these investigations are being carried out at Middletown with special reference to the determination of the energy value of the materials under consideration.

The number of visitors who have come to Middletown the past year for the purpose of seeing the respiration calorimeter and the method of carrying on investigations with it is an evidence of the attention which both the general nutrition investigations and the special inquiry conducted at Middletown are attracting.

European investigators have given much attention recently to the nutrition investigations carried on under the auspices of the Department of Agriculture. This is shown by the unusually large and increasing number of requests for the nutrition publications which have come from abroad. The investigations have frequently been favorably referred to in European scientific publications and, in several instances, publications have been supplied, by request, for use in preparing articles for foreign journals. The articles giving a summary and history of the nutrition investigations carried out by the United States Government, which was prepared by Dr. P. Smolenski for publication by the Russian Government, and which was referred to in last year's

report, has this year been translated into German and published in a leading journal.

In order to keep himself in close touch with the work done by the European investigators on the subject of food and nutrition, Professor Atwater goes abroad this summer with the expectation of spending somewhat over four months in Europe. His plan includes visits to a considerable number of the principal universities and other institutions where such inquiries are carried on in England, France, Belgium, Switzerland, Italy, Austria, Germany, and perhaps Denmark and Sweden. His especial purpose is to meet leading specialists, visit their laboratories, and consult with them about the different phases of research in the general field of the food and nutrition of animals, and especially human nutrition.

In connection with the nutrition investigations, Professor Atwater has by request delivered several addresses at educational institutions and elsewhere. This is one of the many ways in which the results of the inquiry are made available to the general public, and the frequent requests for such addresses indicate the increasing recognition of the usefulness of such research. The lectures given the past year have been as follows:

Summer School of Agriculture, Columbus, Ohio: Two lectures on "The respiration calorimeter and the bomb calorimeter." Third New York State Conference of Charities and Correction, Albany, N. Y.: "Dietaries of State institutions." American Physiological Society, Washington, D. C.: "The sources of muscular energy in the animal body." Brown University, Providence, R. I.: "The respiration calorimeter and the laws of nutrition." Rhode Island Women's Club, Providence, R. I.: "Food and home economics."

#### FOOD AND NUTRITION PUBLICATIONS.

The food and nutrition publications the past year have included six technical bulletins, an article for the Yearbook of 1902, and another prepared for the report of the work of the Office of Experiment Stations of the same year. An article was also prepared for presentation at the Fifth International Congress of Applied Chemistry, held at Berlin in June, which included a history and description of the nutrition investigations, with a general summary of the results. This article will, it is expected, be published in the report of the proceedings of the congress. A brief review of the publications of the year follows:

Dietary Studies in New York City in 1896 and 1897, by W. O. Atwater, Ph. D., and A. P. Bryant, M. S. (Bul. No. 116, pp. 83).

Thirty-six dietary studies are reported of families, in many cases with limited incomes, living in the thickly congested districts of New York City. The results are discussed in relation to dietary standards, and the data obtained in similar studies of families living under different circumstances as regards income and occupation.

Experiments on the Effect of Muscular Work upon the Digestibility of Food and Metabolism of Nitrogen, conducted at the University of Tennessee, 1899-1900, by Chas. E. Wait, Ph. D., F. C. S., professor of chemistry, University of Tennessee (Bul. No. 117, pp. 43).

The results of nine experiments are reported, in which the effects of muscular work upon the digestibility of food and the metabolism of



nitrogen were studied, the subjects of the experiments being healthy young men performing muscular work under different dietary conditions. The bulletin also gives the results of tests of the possibility of determining the composition of any given diet by means of composite samples.

Experiments on the Metabolism of Nitrogen, Sulphur, and Phosphorus in the Human Organism, by H. C. Sherman, Ph. D., instructor in analytical chemistry, Columbia University, conducted in cooperation with Columbia University (Bul. No. 121, pp. 47).

In ten digestion experiments on a diet of bread and milk the metabolism of nitrogen, phosphorus, and sulphur was studied with special reference to the cleavage in the body of the nutrients supplying these elements. The effect of loss of sleep on their excretion was also investigated. Apparently the digestibility of the food was not influenced by loss of sleep or by the continuance of the diet for twelve or eighteen days. Marked loss of sleep for three successive nights resulted in a small increase in the amounts of nitrogen, sulphur, and phosphorus excreted. The increase of sulphur was proportional to that of nitrogen and the increase of phosphorus was very slightly larger, the relative difference being no greater than might be attributed to the usual daily variations.

Studies on the Digestibility and Nutritive Value of Bread at the University of Minnesota in 1900-1902, by Harry Snyder, B. S., professor of chemistry, College of Agriculture, University of Minnesota, and chemist, Agricultural Experiment Station (Bul. No. 126, pp. 52).

This bulletin reports the results of 9 experiments with bread made from different grades of flour ground from hard spring wheat and 15 experiments with bread made from different grades of flour ground from soft winter wheat. In connection with the digestion experiments the income and outgo of nitrogen was also studied. The results of these investigations are in accord with those obtained in former studies, and indicate that fine patent flours from both hard and soft wheat are more digestible than corresponding coarse flours, though they contain somewhat less protein and mineral matter, pound for pound. The investigations also show that all flours are quite thoroughly digested, and furnish experimental proof of the generally recognized fact that wheat flours of all grades are among the most important articles of diet.

The following were prepared during the year:

Dietary Studies in Boston and Springfield, Mass., Philadelphia, Pa., and Chicago, Ill., by Lydia Southard, Ellen H. Richards, Susannah Usher, Bertha M. Terrill, and Amelia Shapleigh, edited by R. D. Milner (Bul. No. 129, pp. 103).

Five dietary studies at the Boston School of Housekeeping, 1 at the Bible Normal College, then located at Springfield, Mass., now at Hartford, Conn., and 27 studies of poor families near Philadelphia and 33 in Chicago are reported. The studies at the School of Housekeeping and at the Bible Normal College are of especial interest, since in the majority of cases the food was planned beforehand, the diet being of a definite cost and so arranged that the nutrients supplied should conform to the commonly accepted dietary standards. These studies show one of the ways in which the results of dietary studies may be practically applied. The results of the studies in Philadelphia and Chicago are of interest for purposes of comparison and in the general discussion of dietary standards.

Further Investigations among Fruitarians at the California Agricultural Experiment Station, by M. E. Jaffa, M. S., assistant professor of agriculture, University of California (Bul. No. 132, pp. 81).

The special object of these investigations, as of those reported in an earlier bulletin, was to study the value of fruits and nuts when these articles constituted an integral part of the diet. Nine dietary studies and 31 digestion experiments were carried out. In the majority of the dietary studies and in all of the digestion experiments fruits and nuts constituted all or almost all of the daily foods. As shown by their composition and digestibility, both fruits and nuts can be favorably compared with other and more common foods. At ordinary prices fruits are not expensive as sources of carbohydrates, and nuts are reasonable as sources of protein and fat. The result of the investigations as a whole emphasized the fact that both fruits and nuts should be considered as true foods rather than as food accessories.

Dietary Studies of Groups, especially in Public Institutions, by C. F. Langworthy, food and nutrition expert (Annual Report of the Office of Experiment Stations for the year ended June 30, 1902, pp. 29).

One of the most obvious applications of the results of dietary studies is in the feeding of large groups, where the saving of a small sum per person per day is a matter of importance. The results of dietary studies in the Army and Navy and institutions where large groups were fed under uniform conditions have been summarized and discussed. In general, it may be said that such studies have shown that it is often possible to materially improve the diet and at the same time diminish its cost or furnish a much more palatable diet for the original cost.

The Cost of Food as Related to its Nutritive Value, by R. D. Milner, of the Office of Experiment Stations (Yearbook of Department of Agriculture for 1902, pp. 19).

This article is an attempt to illustrate the way in which application can be made of the results of the nutrition investigations to the problem of economy in the diet. What is especially necessary is the consideration of the relation between the cost of food and its value for nourishment. In the purchase of other things their value for the purpose for which they are intended is taken into account as well as their cost, and the same principle may be applied advantageously to the purchase of food. A number of illustrations are given showing how this may be done.

#### PUBLICATIONS PLANNED FOR THE YEAR 1903-1904.

Plans have been made for the preparation of the following nutrition publications during the year 1903-4. Most of these are reports of the investigations which will be published in the form of technical bulletins, although at least one Farmers' Bulletin is included and also a Yearbook article.

CONNECTICUT.—A bulletin reporting the results of metabolism experiments with the respiration calorimeter during the year 1901-2 is in press. The report includes experiments in which the diet furnished in some cases large amounts of carbohydrates in proportion to the protein, the object of experiments being to compare the relative efficiency of carbohydrates and fat as sources of energy. The bulletin also includes a description of such modifications of the respiration

calorimeter as have been made since the description of the apparatus given in Bulletin 63. In addition, it includes a summary of the results of all its experiments made with the respiration calorimeter up to the close of the fiscal year 1902 and a discussion of a considerable number of topics relating to the general laws of nutrition in the light of the results of the experiments.

During the year another bulletin will be prepared, which will give a detailed description of the respiration calorimeter in its present form, including an account of the modifications providing for the direct determination of oxygen, which were made possible by the grant from the Carnegie Institution.

In connection with the metabolism experiments, the data of a large number of digestion experiments with a more or less simple mixed diet have accumulated. These results have been published in detail in the annual report of the Connecticut (Storrs) Agricultural Experiment Station for 1901. There is, however, opportunity for a summary of this work and a comparison of it with the results of similar experiments carried on in this country and elsewhere, and the material would furnish a bulletin of considerable size.

Material has also accumulated regarding the digestibility of single foods, including especially the results of the studies made by Messrs. Bryant and Milner on the digestibility of vegetables, and by Messrs. Hawk and Sherman on the digestibility of crackers and milk. The results of these studies and the data for the digestibility of the simple mixed diet would be sufficient for a large bulletin.

A large amount of material has been collated by Professor Oshima summarizing the results of Japanese food investigations. Much of this work was printed in Japanese and is not accessible to students in general. A considerable amount of editorial work is required, but the material is sufficient for a large bulletin.

Since the previous revision of Bulletin 28, a large number of analyses of American food materials have been reported by the experiment station investigators and others, in addition to those which have been found necessary in connection with the nutrition investigations. This material should be collated and combined with similar material in Bulletin 28 for publication as a revision. Plans have been made for revising the manuscript compilation tables, such revision being almost imperative to insure their preservation, as they are much worn by constant use. In view of very recent experimenting, some important changes can be made in the way in which the material may be presented, and the new revised bulletin would undoubtedly prove even more useful than Bulletin 28. The preparation of the bulletin would not involve large additional labor, provided the manuscript compilation is revised as planned.

A Farmers' Bulletin on poultry as food has been prepared by Miss Atwater and is in the hands of the printer.

Considerable material has been gathered by Mr. Milner on the food value of milk. This will be used in rewriting the Farmers' Bulletin on this subject, which may be done this year.

Several other publications have been considered on subjects on which there is sufficient material at hand in the Middletown office, but no definite plans have as yet been made for these. In addition, an article for the Department Yearbook for 1903 will be prepared, summarizing some of the results of the investigations on the nutritive value of bread.



DISTRICT OF COLUMBIA.—A report is being edited which gives the details of the dietary studies carried on during the last fiscal year at the Government Hospital for the Insane in cooperation with the Department of the Interior. The work affords material for an extended discussion and many valuable suggestions for the diet in similar institutions regarding economy in preparation and serving, as well as attractiveness and palatability.

GEORGIA.—President White has reported a number of dietary studies with people of limited means in the mountain districts near Athens. This material can be prepared for publication with but little effort. It has been suggested that the results of these studies be combined with the results of studies made in Tennessee under Professor Wait's direction with similar classes of people and with those of farmers' families made in Vermont by Professor Hills and published in a bulletin with the general title of "Dietary studies in rural districts."

ILLINOIS.—There is now in course of preparation and very nearly ready for publication a bulletin reporting Professor Grindley's experiments, made during 1900–1902, on the losses which occur when meat of different kinds and cuts is cooked in different ways. A second bulletin reporting the results of natural and artificial digestion experiments with the different cuts of meat cooked in different ways, made during the years 1898–1903, inclusive, is now in the course of preparation. Much work has been done, and the bulletin can probably be finished before the first of January.

MAINE.—A bulletin is practically ready for the printer reporting experiments made by Professor Woods in 1900–1901 on the digestibility of bread made from different grades of flour ground from the same lots of wheat. In connection with this work the income and outgo of nitrogen was studied, as well as the amount of metabolic nitrogen in the feces. The bulletin also includes a study of the comparative value of different methods of marking and separating feces in digestion experiments.

MASSACHUSETTS.—Mr. Edward Mallinckrodt, jr., a graduate of Harvard University, has offered for publication his thesis for the master's degree upon dietary studies carried on in one of the Harvard refectories. Mr. John P. Fox, who was formerly connected with the nutrition investigation, at Middletown, has made a number of dietary studies of professional men's families in Cambridge and Boston, and offered them to the Department for publication. Since Mr. Fox's studies were made with professional men after graduation, it seems advisable to combine these with Mr. Mallinckrodt's work with Harvard students. The material, when edited and compared with the results of similar studies, would make a fairly large bulletin reporting dietary studies of professional men before and after graduation.

MINNESOTA.—Professor Snyder has reported the results of experiments carried on in 1902–1903 on the digestibility of bread made from different grades of flour milled from Oklahoma and Oregon wheats. This material can be prepared for publication with but little labor.

TENNESSEE.—During 1901 and 1902 Professor Wait has carried on a considerable number of digestion experiments with a diet of legumes and a few other food materials in such a way as to make it possible to

estimate the digestibility of legumes alone. The results of these investigations might properly be combined with other material of like nature, and published in the bulletin on the digestibility of single food materials, referred to under "Connecticut."

Under Professor Wait's direction, a number of dietary studies have been made during the same year in the mountain regions of Tennessee. It has been proposed, as noted above, to combine these with the results of similar studies made by President White in Georgia, and with those made with farmers' families in Vermont by Professor Hills, in a bulletin reporting dietary studies in rural districts. If, however, it should prove more satisfactory, Professor Wait's dietary studies and digestion experiments may be combined in a bulletin entitled "The results of nutrition investigations at the University of Tennessee in 1901-2."

VERMONT.—The results of four dietary studies of farmers' families made by Professor Hills in Vermont await publication. As before stated, it is proposed to combine these with the dietary studies carried out in Tennessee and Georgia in a general bulletin on dietary studies in rural districts.

#### NUTRITION WORK PROPOSED FOR 1903-1904.

##### CALIFORNIA.

The experimental work in California on the nutritive value and place in the diet of fruits and nuts will probably be continued and extended on much the same lines as in the previous years, with a view to verifying the work and securing data for general deductions. Professor Jaffa has, as previously stated, spent the past year at Middletown, and much of his time has been devoted to familiarizing himself with the literature of the subject of food and nutrition with especial reference to the food value of fruits and nuts and with methods of experimentation. The last few months have been spent in Europe visiting many of the leading specialists in such inquiry. A detailed plan of work for the year 1903-4 will be decided upon in the early fall.

##### CONNECTICUT.

For the year 1903-4 it is planned to make a series of experiments at Middletown to test the accuracy of the respiration calorimeter and to recalibrate the bicycle dynamo. An alcohol check experiment will be made, which will be followed by a repetition of this year's work experiment with carbohydrate diet, arrangements having been made with the same subject to return to Wesleyan for the purpose. It is hoped that this three-day experiment may be followed by one day of extra-hard work, and that immediately by one day of fasting.

It is further proposed to make a rather extended series of short experiments of about one day each to determine the rate of oxygen consumed and carbon dioxide and heat eliminated with men at rest in different postures and with different amounts of clothing. Arrangements are also being made for the construction of an ergometer which will, it is hoped, permit of the study of the very important question of negative work.

The regular analytical work in connection with the experiments will, of course, be continued, as well as the preparation of material for publication.

## DISTRICT OF COLUMBIA.

It is hoped that arrangements may be made for the continuation of nutrition investigations at the Government Hospital for the Insane.

## ILLINOIS.

The studies with meat will be continued by Professor Grindley as in the past, but with improved facilities, as the university has shown itself ready to cooperate more extensively in his investigations and has provided generously for them. The experiment station will also join in the study, and will provide for the experiments, without charge, meat from animals bred, grown, and fattened under known conditions—a feature which will greatly increase the practical value of the results of the experiments.

## MAINE.

In the early fall, under Professor Woods's direction, studies will be begun in cooperation with Professor Snyder, of the University of Minnesota, on the nutritive value of different cereal foods. Some form of prepared oats will doubtless be selected for the first experiments, and later other cereals will also be studied. It is probable that additional studies of the diet of lumbermen will also be made.

## MINNESOTA.

The investigations regarding the nutritive value of bread flour milled in different ways, carried on by Professor Snyder, are to be continued, using wheat of different sorts from those of previous investigations. The Millers' National Federation at their annual meeting expressed their appreciation of the value of the work undertaken at the University of Minnesota, and have petitioned Congress to increase the facilities for such work, and attention will be devoted especially to macaroni wheats. This class of cereals, which promises so much for the Northwestern United States, was introduced by the Department, and it seems fitting that a study of its food value should form a part of the cooperative work in nutrition. There is an increasing desire on the part of local producers and dealers for information of the sort it is proposed to secure.

In addition to his work with wheat flour, Professor Snyder is carrying on studies of the nutritive value of cereal breakfast foods. This work will be along lines parallel to that of the Maine station.

## NEW YORK.

Dr. H. C. Sherman, of Columbia University, will prepare during the year a digest, or series of abstracts, on questions relating to the metabolism of protein, and will continue his work relating to the nutritive value of proteids of different origin. Dr. Sherman spent a month this summer at Middletown, and assisted in the cereal digestion experiments referred to in the account of the work carried out at Middletown.

## TENNESSEE.

Professor Wait proposes to conduct further dietary studies with families in the mountain districts of Tennessee similar to those which were carried on under his direction by Professor Gilman last year, and



to continue his digestion experiments with legumes at the University of Tennessee.

#### ADDITIONAL LINES OF WORK.

There are three lines of work, in addition to those mentioned above, which it seems desirable to pursue, namely, dietary studies in public institutions, nutrition investigations in the Tropics, and dietary studies in rural regions.

The term "public institutions" is interpreted liberally to mean any large group which is fed under more or less uniform conditions. In some instances the food is provided with public money and in others with private funds. The Army and Navy furnish examples of large bodies of men fed at the expense of the General Government. Different State and municipal governments maintain hospitals, sanitariums, homes for incurables, orphan and foundling asylums, insane hospitals, industrial schools, almshouses, prisons, jails, and other charitable, reformatory, and penal institutions. Schools, colleges, and universities are in a sense public institutions, and, indeed, are often maintained wholly or in part by State appropriations. In most cities and large towns charitable organizations which differ in many respects from those mentioned—such as homes for the aged and infirm—are supported by donations and endowments. Another group differing in many respects from those mentioned comprises convents, monasteries, and similar religious institutions. As examples of large groups of an entirely different character fed under uniform conditions by private enterprise may be cited patrons of large hotels and boarding houses, especially those maintained for employees in factories, lumber camps, mines, etc., as well as the groups provided for in provisioning ships, camps, and expeditions. The total number of individuals in the United States which may be fairly included in the different groups mentioned above is undoubtedly very large, though it would be difficult to make a reliable estimate of the number. While statistics of the subject as a whole are not available, some idea of its magnitude may be gathered from the statement that in the State of New York alone there are upward of 100,000 persons of the dependent and delinquent classes who are housed, fed, and clothed in public institutions at a cost to the State of \$26,000,000 per year. Not far from one-fourth of this sum, or about \$6,000,000 annually, is expended for food. This furnishes an indication of the vast interests at stake in this matter when we consider the question as a whole.

It is evident that in all lines of work general principles must be understood and a considerable amount of information must be available before special questions can be satisfactorily considered, particularly with reference to their bearing upon the general subject. This is as true of dietetics as of physics or chemistry. There has been a large amount of experimental inquiry during recent years regarding the food and nutrition of man, and as a result of the extended inquiries in this country and elsewhere the general principles of nutrition are fairly well understood to-day, and the results of experiments and experience can be applied.

In public institutions, such as prisons, hospitals, and orphanages, it is now possible to study rationally the kind and amount of food supplied, as well as its cost, and the physiological demands of the inmates, in this way securing data for comparing dietary conditions with those

prevailing in kindred institutions and with commonly accepted dietary standards. Taking into account the cost of the food and the actual needs of the persons nourished, an estimate can be formed of the value of the diet from a pecuniary standpoint and whether or not it is economical. In the light of past experience it seems fair to assert that the knowledge thus obtained frequently shows where and how improvements may be made in the purchasing, storing, cooking, and serving of the food which will render the diet more attractive and palatable, and, if necessary, better balanced and more nutritious, while at the same time the cost may be frequently lessened.

As noted earlier, systematic investigations in public institutions, begun last year at the Government Hospital for the Insane, have made very satisfactory progress, and it seems certain that further food investigations in public institutions is a field upon which the Department may well enter with the hope of securing results of great practical value.

In connection with the work of the Washington office, special efforts have been made to collect the available literature regarding food conditions and nutrition investigations in the Tropics, and in addition considerable original material has been collected regarding food supplies, market conditions, and dietary habits in the tropical regions. In earlier reports attention has been called to the fact that investigations along such lines are much needed. The matter is becoming of increasing importance since so many soldiers, sailors, and civil officers, as well as those who are called thither by our extended commerce, are compelled to live in tropical countries. Such facts would seem to justify the institution of investigations having for their object the determination of the most suitable diet for such climatic conditions. It has long been recognized that suitable diet has a marked effect upon the maintenance of health of old residents of tropical countries and is a matter of the first importance with newcomers.

Much attention is of necessity devoted to this subject by our own Army and Navy and it has received even more attention at the hands of German, British, and other European governments, especially in its bearing upon the health of troops.

There are many tropical food products, comparatively unknown to residents of other regions, which it may be possible to profitably utilize when their true food value is ascertained. Furthermore, a study of the dietaries of the native inhabitants in relation to their capacity for the production of useful work and their continuance in good physical condition would undoubtedly prove of great value in determining dietary standards and proper food combinations suitable for the inhabitants of warm regions.

The subject of food conditions in rural regions has already received considerable attention in connection with the nutrition investigations of this Office and results of value have been obtained. While it is evident that in many regions the farmers' families have an abundantly varied and nutritious diet, it is equally true that in other sections their food falls below the desirable standard largely through a lack of appreciation of the palatability and nutritive value of food products which could be produced locally. For instance, it has been found that in some of the mountain regions of the Central and Southern States the diet is limited to a few staple foods, and would be considered far from satisfactory by the majority of persons. Frequently it would be pos-

sible to secure a satisfactory and varied diet with comparatively little effort if the importance of poultry, milk, fresh green vegetables, and some leguminous crops was understood. It seems fair to say that as regards rural dietetics as a whole, it would be possible in a large majority of cases to add to the attractiveness and value of the diet by extending information regarding the relative value of different food products which may be readily grown or procured, by disseminating information on the methods of storage and preservation of foods, and in similar ways. In order to do this satisfactorily it is necessary to understand existing conditions, and it is believed the desired data may be readily secured by continuing the lines of work which have proved so profitable in the past.

In order to extend the nutrition investigations by carrying on dietary studies in public institutions, among the rural population in different parts of the United States, and studies of the food requirements of persons residing in the Tropics, I recommend that \$10,000 be added to the appropriation for nutrition investigations for the fiscal year of 1905.

#### IRRIGATION INVESTIGATIONS.

The investigations carried on during the past year by this branch of the Office of Experiment Stations, as provided for by Congress, may be grouped under the following heads:

(1) The determination of the amount of water needed in irrigation and the methods of applying it to crops to secure the best results.

(2) The improvement of methods of distribution in order to lessen the cost of water to farmers, and reduce the waste from evaporation and the loss and damage caused by excessive seepage.

(3) Investigations of drainage problems (*a*) to prevent the injury of irrigated land through the accumulation of surplus and seepage waters and (*b*) to reclaim swamp and overflowed lands by aiding farmers in the settlement of general drainage problems.

(4) Investigations of the best means of applying power in pumping and other branches of farm work.

(5) Studies of irrigation institutions, including the laws and customs under which rights to water are acquired and enforced, and the corporate and cooperative institutions which affect the economic relations of water users.

The first branch of these investigations deals with a question which confronts every farmer in the West. Every improvement which is made in the distribution and application of water to crops is a direct benefit to the individual farmer and to the nation at large. It helps the individual by lessening his bills for water and reducing the damage to the soil through its excessive use. It is a gain to the nation in increasing the service which streams can be made to perform and extending the area and increasing the productivity of land brought under cultivation. From their inception, the value of these studies has been appreciated by farmers. The work already done has had a distinct influence on irrigation methods in lessening waste and in increasing the yield and value of crops. The demand for the continuation of these investigations and for their extension to other sections of the West is now more pressing than ever before.

In the past the Office has made an extended study of existing methods. This was to secure a basis for an intelligent effort to improve



these, as well as furnish directions to the large number of persons who every year undertake irrigation for the first time. The work this year includes the determination of the amount of water needed to give the best results, the time when it should be applied to crops, and the methods of application best suited to different localities and different crops.

Measurements for determining the amount of water actually used in irrigation and special investigations to determine how it should be applied to particular crops are being carried on in 16 States. In most of these States this work is being carried on under cooperative arrangements with the State agricultural experiment stations.

The measurements made in former years showed that some farmers used from five to ten times as much water as others who were raising the same crops under apparently similar conditions and who were securing as good or better results. Such wide differences in practice suggested the need of finding out the actual water requirements of crops. As a basis for this investigation experiments are being made in California, in which the water actually used by the plants is being measured. It is hoped by these experiments to establish an approximate minimum quantity of water which must be supplied to plants to maintain healthy growth. With this as a basis, the additional quantities necessary to supply evaporation and other losses which are unavoidable under field conditions can be determined with greater exactness. The same problem is being taken up from the practical side. Experimental fields have been planted. In these fields different quantities of water are being applied to crops where all other conditions are made as nearly uniform as possible. In this way the quantity of water which will produce the largest returns can be determined. Such experiments are being carried on in cooperation with a number of the State experiment stations. The first object of such a study is the production of maximum crops. If too little water is used, yields are reduced and there the injury ceases. Also, if too much water is used, yields are reduced, but an endless chain of evil consequences is set in motion. The second object of limiting use to necessity is the avoidance of these evils.

A study of the irrigation of natural hay meadows on the Laramie Plains, Wyoming, made during the summer of 1902, showed that the use of too much water had killed out the nutritious natural grasses and replaced them with water-loving plants of little value as forage. The same thing has occurred in other sections. The same quantities of water used on a larger area, or to raise alfalfa and other hay crops, would have given much better returns.

The most prominent feature of the report made by our agent in the State of Washington in 1902 is the discussion of the evils resulting from the use of too much water, the swamping and ruining of large areas which were only a few years ago highly productive farms. The same condition exists all over the West. The first remedy which suggests itself is to stop using more water than is necessary. But how much is necessary? This the Department is attempting to find out. Farmers can not make these experiments for themselves, because they are dependent on their crops for a living and must apply enough water to make sure of a crop. It is, therefore, the duty of this Department to make the experiments, and this is being done, as has been pointed out.

The use of water in excess of the needs of crops not only reduces the yields of the crops and ruins large areas of fertile lands, but it deprives other lands equally fertile of a water supply. No accurate estimate of the volume of water wasted in this way can be made, but the measurements made in former years, referred to above, seem to justify the conclusion that on an average at least twice as much water is being used and lost as is necessary. On this basis, a limitation of use to the necessities of plants means better yields from the areas now farmed, the checking of damage by swamping and alkali, and the doubling of the area which can be irrigated with the existing water supply. The reduction of yields by the failure to use the proper quantities of water is reason enough to justify the work being done on this line, but the damage done by the surplus makes the continuation and enlargement of this work imperative.

In California investigations are being carried on under a cooperative arrangement with the State, under which the work is directed by this Office, the expense being shared equally by the State and the Department. In southern California the investigations have great interest because we are working in a district recently brought under irrigation, where a system which embraces 60 miles of main canal and about 500 miles of laterals is being developed under conditions which are new and strange both to the canal manager and to the farmer. Before the completion of the canal the land was an uninhabited waste. The settlers who are improving it have come from all parts of the United States. Many of them are practicing irrigation for the first time and have to become accustomed to the climate and soil as well as to the requirements of irrigation. Without the aid of an investigation similar to that inaugurated there would be no way for them to learn the amount of water required to grow crops and of the losses which will arise from seepage and evaporation except through the long and wasteful method of experience. That the investigation will hasten the adoption of proper methods of increasing the productive value of that territory is certain, and our advent in that district has been warmly welcomed by all interested parties.

In the older settled irrigation districts of California, especially in central and northern California, there are sections where it is possible to grow crops by rainfall alone, but where the yield and value can be greatly increased by the addition of a supplemental supply through irrigation. There are other sections where a small additional supply will permit the growing of crops, and still other sections where frequent irrigation is an absolute requisite. The best development of all of these regions will be greatly hastened by comprehensive investigations to determine when water is needed, how much is needed, and how it should be applied. These studies, to be conclusive, require the services of trained scientific investigators, and embrace an area and equipment wholly beyond the means of the individual or community. It is an appropriate field for the work of this Office, and has been entered upon with the purpose of giving the farmers of the whole country all the benefit which science can offer in the prosecution of their work. Prof. Samuel Fortier, who has shown marked ability as an investigator along these lines, has been engaged to direct this work. The principal fields of investigation at present are the substations of the State agricultural experiment station at Tulare, Pomona, and Calexico. The work at these places is being supplemented by studies of the amount of water

used under ditches under common methods on the most important crops in the Santa Clara, San Joaquin, and Salton valleys.

Similar investigations are being carried on in Oregon under the direction of Prof. James Withycombe, director of the State agricultural experiment station at Corvallis. It is Professor Withycombe's belief that the productiveness of 3,000,000 acres of agricultural land in Oregon can be greatly increased by the adoption of cheap and simple methods by individual farmers for conserving the moisture which falls outside the irrigation period. Measurements of the water used are being made to ascertain the requirements of crops, and a preliminary study of the State, to determine more definitely where work can be carried on to be most instructive to the farmers interested has been made this year.

In Montana, Utah, Wyoming, the eastern part of Washington, and the western part of Kansas and Nebraska there are large areas where, in favorable seasons, crops can be grown without irrigation, but production can be greatly increased by making the best possible use of the available moisture. This can be done by the building of small storage reservoirs, by turning the flow of small streams over the land in the nonirrigation periods, thus providing a storehouse of moisture for the summer months, and by cultivating the land in a way to conserve this moisture. Tracts for the study of the effects of winter irrigation, the feasibility of small storage works, and the distribution of storm waters during the nonirrigation periods have been selected at Great Falls and near Bozeman, Mont. This work is under the direction of Prof. J. S. Baker, of the Montana State Agricultural Experiment Station.

If these investigations shall prove, as it is believed they will, that it is within the means of individual farmers to make productive large areas for which a complete water supply is not available, it will add immensely to the area brought under cultivation in different sections of the arid region, and do so at less expense than is involved in the construction of canals and reservoirs for the more arid sections of that portion of the United States.

In Kansas the best methods of utilizing small sources of water supply are being studied and experiments are being carried on, to determine the amount of water needed and the cost of supplying it. Great improvement in the conditions of ranch life on the Plains can be brought about by the use, in irrigation, of the water supplied by springs or pumped from wells or impounded by damming draws so that they will catch the storm waters from considerable areas. The people of that section need to have demonstrated for them the advantages of making such a use of the small quantities of water which they can obtain, and then to be shown the best methods of securing, handling, and using water.

A report on the storage of water in small reservoirs in northern Colorado built by the cooperation of the farmers using the water has been published as Bulletin No. 134 of this Office. This report shows that immense profits to the farmer have resulted from the use of these reservoirs, and gives details of methods and cost of construction and plan of operation.

Other methods of storage are also being studied.

The work on winter irrigation has been mentioned. In Utah a practice known as swamping is being followed. During the winter and



spring, when the water is not needed for direct irrigation, it is run out of the streams onto the sidehills along their upper courses and spread on the land, the aim being to put water on the land only so fast as it will be absorbed by the soil. This water seeps back into the streams later in the season and increases the supply of water the same as if it had been stored in reservoirs. This practice has not been followed long enough to determine its relative cost and efficiency as compared to reservoirs, but it has proven useful where reservoirs were considered out of the question.

#### SEEPAGE.

The measurements of former years have shown that the losses from seepage in canals are much greater than has been commonly supposed, and the injurious rise of water in the soil in the older irrigated districts has shown that this works a double evil. This Office is carrying on a series of investigations to determine the best means of preventing these losses. The first thing is to determine whether they are extended throughout the length of canals or occur only in particular sections. The annual report of the irrigation investigations for 1902 contains seepage measurements of a large number of canals made for the purpose of locating the points where the losses occur. This report shows that the water lost from Big Cottonwood Creek in Utah, in a distance of 2.5 miles, if saved, would have produced crops worth \$115,000 a year, and that a considerable area of land would be raised from its present value of from \$10 to \$75 per acre to from \$200 to \$500 per acre. In this neighborhood rock-lined channels have proven to be efficient water carriers and the loss from the stream named could be stopped by lining its channel in this way. The two Wood rivers in Idaho flow through lava beds where almost the entire flow sinks. Measurements show that the channels, as a whole, lose little water, and that these losses occur in comparatively short sections; also that if these sections could be improved the streams could be made practically impervious. Similar studies are being made in other parts of Idaho this year to locate the points where the water is lost and to suggest plans for preventing these losses.

Leakage from ditches is a very serious question in the extension of irrigation in the eastern part of the United States. It has been found practically impossible to irrigate the sandy lands of Florida by means of earthen canals. The water all sinks before it reaches the ground to be irrigated. There has been a similar experience in both Wisconsin and New Jersey, and experiments are being made under the direction of this Office to determine whether or not some cheap and effective way of lining canals and distributing water can be found. Puddling the ditches with clay has been tried, but has not been successful. Large tarred duck hose was also tried, and in New Jersey the use of tarred cloth to line ditches seems to be a successful expedient. This is comparatively inexpensive for small ditches and the value of the water in irrigation of small fruits and vegetables will permit of the outlay.

Our studies of this subject in the United States have been supplemented during the past summer by a study of canal management in Italy, by Prof. Elwood Mead, chief of irrigation investigations. There the losses from seepage have rendered it necessary to line many canals with cement. In some places the damage to towns and counties caused by seepage water has also been serious enough to make the sub-

ject a matter of legislation under which drainage is made compulsory and Government aid is extended wherever it is necessary.

The losses from canals which divert streams carrying large amounts of sediment are very much less than those from streams where the water is clear. The silt fills the crevices in the sides and bottom and soon forms a practically water-tight lining. Where the water is clear, however, as it is from reservoirs, this silting material is absent, and the losses are not only larger, but practically undiminished. The investigations of Professor Mead in Italy show that the canals from muddy rivers do not have to be lined, while many of the canals diverting from rivers whose water is clear have to be.

The losses from large canals in the United States vary, of course, with the soil and with the character of the water supply, but in many of them it is from 25 to 50 per cent of the water entering the head gates, and the loss along the laterals is equally great. The saving of these waters, therefore, means an increase of more than 50 per cent in the available water supply or the doubling of the area irrigated; but the benefits to come from this saving will be more than this gain in crops and in the watered area. Seepage water from canals and laterals not only often finds its way where it can not be made available for subsequent irrigation, but it also prevents the cultivation of large areas of land through the rise of the ground water until the land becomes too wet for crops. In addition, this brings up the alkali which has been dissolved and makes the land still further unfit for cultivation. This loss of water, therefore, not only restricts the extension of the irrigated area, but tends to reduce the area already irrigated.

Material is now being gathered for a bulletin on the proper location and construction of field laterals. All the agents of the irrigation investigations have been requested to collect information showing the best practice of the farmers in the districts where they are at work. From their reports a bulletin will be prepared which will exhibit the best results of practical experience thus far. The facts being gathered will enable the Office to advise farmers and canal managers as to the best plans for distributing water over their fields at the least expense and with the least loss.

#### DRAINAGE.

It frequently happens that the irrigation of uplands causes the swamping of the fields below, rendering it necessary to construct drains to intercept or draw off the surplus supply. A study of the sources of this supply and the means of shutting it off or removing the surplus is inseparably connected with a study of the methods of distributing water in irrigation, and these two lines of work are being carried on together.

One of the most interesting fields for this study is at Fresno, Cal., where 25 square miles of very valuable fruit land have been injured by the surplus water supply. A special study of the conditions which gave rise to this excess of water and the best means of getting rid of it has been made, and plans and recommendations as to methods of reclaiming this land have been prepared for the farmers. A preliminary report upon these plans has been issued as Circular No. 50 of this Office, and a more detailed report will be published later.

The Yakima Valley in Washington is one of the most fertile districts

in the West, and large areas have been brought under cultivation. This has been accompanied by a rise in the ground water and in the swamping of tracts of land which were under a high state of cultivation. The drainage expert of this Office has made a study of this district, and advised the community as to the best plan for relieving the overwatered lands.

In response to a petition from the settlers of the Grey Bull River Valley in Wyoming, and from the State officials of Wyoming, a study of the conditions in this district was made, and a recommendation as to the construction of intercepting ditches to carry off the water before it reaches the farms has been submitted to the settlers.

Requests for advice about the removal of seepage water have been so numerous during the year that it has been beyond the means of the Office to respond to all of them, and it will be necessary to extend this work in the future. There is a special reason why the Government should lend this aid. The injury to each farmer's land does not come from his own neglect or wasteful use, but from the watering of other areas, which action is being encouraged by the Government so that the individual settler in many instances is a victim of the country's growth and of a recognized State and National policy. The improvement of his condition is, therefore, a public question, and is so treated in other irrigated countries, in many of which not only does the Government aid settlers by means of suggestions and advice, but also appropriates money for the construction of needed works.

Numerous requests have also come to this Office for advice about agricultural drainage in the eastern part of the United States, and especially in the South, where there are large areas of fertile land which, if drained, could be made immensely productive. The carrying out of these projects is beyond the means of the individual settler. To make them a success, farmers must be organized, but before they organize they wish to know that the improvement is possible. The public welfare will be greatly promoted by this work. Every consideration which justifies the extension of aid in the reclamation of arid lands applies with equal or greater force to the furnishing of needed advice about the reclamation and improvement of these overwatered lands. A beginning has been made in this work and it should be extended. This land would have exceptional value because its fertility has not been exhausted by long cultivation. It is located where transportation is cheap and where there is direct access to densely populated districts. The farmers are there, the markets are there, and the soil is there. A careful investigation shows that in the aggregate these swamped areas have a productive capacity equal to four times the State of Illinois, and the inauguration of their improvement takes rank among the important public agricultural movements of the country. The purpose is not to construct works or to supervise the construction of works, but to determine whether construction is practicable and to offer encouragement for the beginning of this work by private enterprise by showing that the work can be done and how it can be done.

In this connection, there is another branch of hydraulic agriculture in which there is need of additional work by this Office. It is an unfortunate fact that much of the activity expended in subduing and settling the eastern part of the United States has been of a destructive character. Forests have been cut from the headwaters of streams, and the hillsides which they clothed and protected exposed to the erosion of



storms. The evils of this condition have been aggravated by the planting of these lands to crops which require clean culture, like corn, tobacco, and cotton, which provide no binding material in the soil to prevent its being washed away by the winter rains. The result has been that the fertile covering of the hillsides has been carried down into the channels of streams, changing the conditions of many rivers, especially in the Upland cotton-growing districts of some of the Southern States and on the hill lands of Ohio, Indiana, Kentucky, and Tennessee. Thousands of acres of what was, not many years ago, good land are now scarred with gullies and practically abandoned to weeds and brush. We must stop this destructive action if we are to maintain the prosperity of these sections.

To find out how best to do this and to encourage farmers to begin action is a work which this Office has under consideration. There is no question that it can be done. The hillsides of eastern France and western Germany are as steep and the annual rainfall is as great as with us, yet these lands are as fertile now as they were a century ago, although they produce a crop every year. This result has been achieved through improvements suggested by trained agricultural engineers, a class of professional men much needed in the United States. The work of this Office in stopping this waste should be educational—the preparation of reports showing farmers that it can be done, and advising them about methods of doing it. The combination of tree planting, terracing, and drainage employed in Europe needs to be made familiar to our people. A beginning in this work as a part of the drainage work of this Office has been made in connection with some irrigation investigations in Georgia in the laying of a series of tile drains to determine their efficiency in the prevention of erosion of hillsides.

#### THE APPLICATION OF POWER TO PUMPING AND OTHER BRANCHES OF FARM WORK.

In many parts of the country pumping furnishes a convenient means of providing the farmer with a water supply for irrigation. It is often cheaper for the individual farmer to place a pump on the bank of a stream to lift the water to his land than to construct a canal and carry it there by gravity. In some places where it is not possible to secure a gravity supply, it can be obtained by means of pumps, either from wells or from the channels of streams. Hence there are thousands of farmers pumping water for irrigation or thinking of doing so. These men apply to this Office for advice. They wish to know how much water is required, and when it is required, in order to determine the kind and size of pump to purchase. They desire advice regarding their operation, because the skill with which pumps are operated will in many instances determine whether or not irrigation is a financial success. The number of these pumps in operation at the present time runs into the tens of thousands, and the saving to the farmers which the advice of the agents of this Office has already effected runs annually into a large sum of money. It is evident that the use of pumps in irrigation is certain to increase greatly in the future, and the money value to the country of having them operated efficiently will be proportionately enhanced. A report upon the cost of pumps and the expense of operation in the Hawaiian Islands is

included in the Report of Irrigation Investigations for 1902, Bulletin 133 of this Office.

During the past year the agents of this Office have included in their reports data on pumping wherever anything was being done in the fields covered by their work. In this way considerable information regarding the area served by pumps of different sizes and their cost and efficiency has been brought together and published, and has enabled this Office to answer inquiries along this line.

At present a more systematic study of pumps and the different kinds of power used in their operation is being carried on, especially in California, where they are more generally used for raising water for irrigation than elsewhere in the United States. Pumps are also extensively used in the rice districts of Louisiana and Texas and data are being collected there. The large rivers of the Plains, such as the Arkansas and the Platte, furnish little water during the summer, but there is usually a good supply only a few feet below the surface of the channels and in the bottom lands bordering these streams, and the surest and often the cheapest way of making this water available for irrigation is by the use of pumps. The number of these plants is being rapidly increased. This has brought a large demand for advice regarding the feasibility of pumping in this district, in order that farmers may know whether or not the returns will justify the outlay.

A simple means of lifting water is by current wheels, and numerous inquiries come from farmers asking for advice about their construction and efficiency. During the present season the agents of this Office throughout the country have been collecting plans and photographs of these wheels in operation, and determining the height and amount of water lifted. The facts thus gathered will be arranged and published as soon as possible.

In some of the older irrigated sections of the West the ground water has risen until only small lifts are required to bring it to the surface for the irrigation of additional lands. A pumped supply is frequently cheaper than water taken from ditches, and equally reliable. The advantages of pumping in such localities are not limited to the individual. The public is interested in having the largest extension of this sort of improvement because many acres which will then be watered would otherwise remain desert, while the operation of these pumps will prevent the soil water rising to the danger line. There is no way of accurately estimating the total water supply available from such sources, but enough is known to justify the statement that the pumping of underground water ranks with the improvement of canals and economy in use as a means of extending the area which can profitably be irrigated. The field is one of the most promising in which we are now engaged, and nothing should interfere with the progress of the work.

While the study of power is being made primarily with relation to its use in running pumps, the information collected will prove useful in other lines of farm work. The long-distance transmission of electricity has made it possible to develop and distribute power so cheaply that it can profitably be applied to many classes of farm work. Farmers now use it to thrash grain, hull rice, run their dairies, and light their homes. Competition makes it necessary for our farmers to adopt every means of cheapening production, and the use of power for operating farm machinery promises much in this line. Power has

been largely used on great ranches, but has not been adapted to the needs of the man who is farming on a small scale and doing his own work. The work now being done by this Office is of especial value to this class of home-making farmers, as it will help to put them in a position to compete with those who can take advantage of the economies made possible by doing things on a large scale. This work could well be extended to include laboratory and field tests of the relative efficiency and cost of different kinds of power (hand, animal, steam, gas, hot air, compressed air, water, wind, and electricity), and the best methods of applying them to different kinds of farm machinery under varying conditions; also a study of farm machinery with a view to adapting it to operation by mechanical power.

#### IRRIGATION IN THE EASTERN PART OF THE UNITED STATES.

Irrigation in the humid portions of the United States is proving profitable and resulting in a large increase in production. The irrigation of rice in Louisiana and Texas is becoming an important factor in the prosperity of those States and is being rapidly extended. The methods employed along the Gulf coast differ widely from those used in rice irrigation along the Atlantic seaboard, and there is a demand for information regarding the quantity of water needed, the best methods of raising it from streams, the cost of pumps, engines, and fuel, the construction of laterals, and the application of water to crops.

Considerable attention has been given to the operation of engines and pumps in the irrigation plants already installed, and arrangements are being made for testing the efficiency of small engines used by farmers in pumping from wells, in the laboratory of Tulane University at New Orleans, during the coming winter. This will be done without expense to the Government. Among the pumping plants examined are examples of the best kinds of engineering and also some conspicuously bad examples, showing the need of a diffusion of information regarding the principles which should govern in this work.

This Office is also cooperating with the Bureau of Chemistry of the Department in studying the influence of salt water on crops and soil, the field agents gathering the samples, which are forwarded to the Bureau of Chemistry for analysis.

In the South Atlantic States rice culture is having to contend with some troublesome conditions created by the cutting off of the forests on the headwaters of streams and the filling up of channels with the soil washed from the hillsides. This has forced rice growers to contend with a wider fluctuation in streams, and has made it necessary for them to adopt new methods of supplying water. A partial investigation of the problems confronting the rice growers along Cooper River was made in the spring of this year to determine the feasibility of providing a supplemental water supply in times of scarcity and also to advise the farmers regarding the best means of protecting their dikes from floods.

An investigation of the requirements of cranberry irrigation is being carried on in cooperation with the State experiment station of Wisconsin. This investigation includes a study of both the irrigation and the drainage requirements of this crop. Wisconsin has provided for the carrying out of this work and a lease has been secured from the Wisconsin Cranberry Growers' Association of about 9 acres of land 10



miles southwest of Grand Rapids. In this the association has already planted a number of different varieties of vines representing all those grown in the United States and Alaska, as well as others received from foreign countries, including Norway, Russia, Siberia, and Canada. With this there are 2 acres of standard vines, and the results of applying different quantities of water and different methods of application will be studied. A small reservoir has been constructed and measurements of seepage and evaporation have already been begun. The success of the cranberry industry depends upon the proper use and control of water. It must be applied at the right time and it must be withdrawn quickly at the right time. Until the last few years there was no attempt made in growing cranberries in Wisconsin to exercise control over the water. If nature failed to cover the vines at the right time or uncovered them at the wrong time, the crop would suffer. The severe drought of 1895 almost destroyed the industry in that State. With the revival of this industry have come better methods; dams are being built to collect the surface water; canals are being constructed to carry water pumped from the streams. The development of the industry and the extension of the area under cultivation have brought new difficulties. More water is needed, requiring larger ditches. Greater uniformity in the matter of drawing off water is imperative to prevent the operations of one neighbor damaging those below him. Much litigation has been caused by a lack of arrangements for cooperation and by the construction of inadequate works. This calls for more knowledge as to the principles which should govern in this work, which this Office is endeavoring to collect and provide. In order to make this effective expert direction is needed. Through the lack of this many costly failures have occurred. The work undertaken is being prosecuted along the following lines:

- (1) The collection of data from growers as to the amount of water used and their methods of applying it.
- (2) The determination of losses from seepage and evaporation from ground covered by vines as well as from reservoirs.
- (3) The determination of the effect of standing water at different temperatures on berries and vines in various stages of development and under various conditions of weather.
- (4) The determination of the coefficient of resistance of peat ditches used for carrying water to and from the vines.
- (5) The determination of the most effective methods of using water to prevent injury from frost.
- (6) The effect upon the cranberry marshes of the drainage of adjacent areas for farm purposes.

The results of the present year, while not conclusive, show how greatly the success of this industry will be promoted by an efficient system of canals for getting the water onto the ground and getting it off. On June 11 of this year there was danger of frost. Those who had proper ditches saved their crops. Those who were not so provided lost them. A conservative estimate of the loss in the Cranmoor and Mather regions places this loss at \$25,000. The damage due to improper drains in this region, which prevented the removal of the water in time, was greater than that from frost, so that from these two items in the two districts there was a net loss this year of over \$75,000, a sum which would probably be nearly sufficient to construct a system of canals to meet the demands of both districts.

The severe drought which prevailed in the New England and North Atlantic States during the early part of the present summer showed not only the importance of irrigation to market gardeners and others growing high-priced products in this part of the country, but gave an excellent opportunity for observing the effects of irrigation where it was made use of. The facts regarding the operation of a considerable number of private irrigation plants have been collected for this Office by Prof. E. B. Voorhees, director of the New Jersey State Experiment Station. There was also carried on in New Jersey some systematic studies of the effect of irrigation upon asparagus, other vegetables, and small fruits, and on the sandy lands in the southern part of New Jersey.

#### IRRIGATION INSTITUTIONS.

The farmers who have reclaimed the arid lands of the West are learning that the legal, social, and business questions of irrigation are vital factors in their success. Instead of each man being able to work independently of his neighbor, as they were accustomed to do in the East, they find that what their neighbors do has almost as much influence upon the outcome of their year's work as what they do themselves. It is impossible for each farmer to build his own canal and divert the stream independently of his neighbor. The wasteful use of water by the irrigator at the head of the lateral means drought and loss of crops to the man at the lower end. The people of communities are bound together by a common tie of dependence on the canal which diverts the stream and on the stream which makes the soil productive, and the laws and business methods for carrying out this distribution are a controlling factor in the prosperity of the irrigators and the peace and well-being of those who live on irrigated lands. The arrangements for opening and closing the gates of ditches and for keeping laterals in proper condition to carry the needed water supply does as much to determine whether communities shall live in peace or be at war as does the character of the people, and the working out of the laws and business arrangements under which these are carried out involves the settlement of many practical questions and careful study by trained men. Shall water be divided by time or by volume? Shall it be measured by weirs or orifices? Shall laterals be under the control of the canal companies or be managed by the farmers who live along them? These are examples of questions in irrigation economics which this Office is investigating and on which the studies of irrigation in Italy by Professor Mead will throw new light. The conditions imposed by water-right contracts framed by canal companies have almost as much influence upon the well-being of farmers as the laws which govern the rights to rivers and determine how their flow shall be divided. The nature of these legal, social, and industrial questions under which water is being controlled, divided, and used has been an important subject of study by this Office, and it was made so because no farmer in the arid West is free from the influence of these institutions.

The obtaining of a water right, either under the laws of a State or from an irrigation company, is a necessary preliminary to the use of the water itself, and the limitations governing the right thus obtained often have as great an effect on the prosperity of the farmer as the nature of the soil or the character of the stream from which he procures his flow.

The number of acres of land made productive and the number of people who will ultimately live in the arid region will depend more largely upon the right use of the water supply than on any other single influence, and the social well-being of those people will be more vitally affected by the justice or injustice of the laws governing water ownership than by any other legislation which either the State or nation is likely to enact. A correct understanding of the social conditions created by the laws already enacted is desirable as a guide to emigrants wishing to settle in the arid region and in the future development of those regions. We need to know definitely whether the public streams are being disposed of in a manner to protect the rights of users or are being given away extravagantly to speculative owners. We need to know whether grants to water are being restricted in such a way as to protect the public welfare or being given away to speculators. The litigation, controversy, and uncertainty over water titles which prevail in Western States shows that all development has not been beneficial, and that along with great material progress there have been deplorable results in the way of extravagant water rights, uncertainty regarding the division of streams, and apprehension as to whether or not there is water enough to satisfy rights already declared legally vested.

The study of these questions by this Office has for its sole object the promotion of irrigated agriculture. The work of the experts in the field in determining the manner in which farmers use water, in ascertaining whether or not the contracts under which they obtain it are just and equitable, and in learning the causes and cost of controversy and litigation has done much to educate public thought and enlist the interest of public-spirited citizens and to make the irrigation institutions of this country the equal of those of other civilized nations where irrigation is practiced.

The beginning of this work was a comprehensive investigation of conditions in California. This was followed by the report on investigations made in Utah in 1900-1902, which was published in 1903 as Bulletin No. 124 of this Office. The introductory chapter of this Utah report treats of the development of irrigation law in that State which led up to the passage of the enlightened law of 1903, which came largely as a result of the investigations made by this Office. A study of its operation is being made during the present season.

Similar studies of irrigation conditions in Nevada have been completed and a portion of the results has been published as a bulletin of the State experiment station of that State under a cooperative arrangement with this Office. A final report of this investigation, together with that of studies in one of the oldest districts in Montana, will be published in the near future.

As showing the interest being taken in the enactment of better codes of irrigation laws and the value of the studies made by this Office, the following facts may be cited: A bill drawn along the line suggested by the experts of this Office in their report upon irrigation conditions in California was presented to the last legislature of that State. This bill was not passed, but its presentation and discussion were important preliminary steps toward the adoption of a working code of laws. A law drawn upon the same general lines was presented to the legislature of Montana in 1903, while in Utah, Idaho, and Nevada laws in



accordance with the recommendations of the experts of this Office were enacted.

A study of the questions growing out of the use of interstate streams was begun in 1902 and is being continued during the present season. The Platte River with its two main branches was chosen as presenting a concrete illustration of these questions. This stream rises in Colorado, flows through Wyoming, thence across Nebraska. Rights to the water of the river in each of these States are established by State tribunals under laws which differ in some particulars and irrespective of the rights to the same supply in the neighboring State above or below. This Office is collecting information to show the extent of the diversions already made, the nature of the rights acquired, the amount of water controlled by these rights, the effects of irrigation above on the flow of the stream lower down, the use to which the water is put, the losses from seepage and evaporation in different sections of the stream, the methods of irrigation, and the value of the water to irrigators in the different States involved.

It is of the highest importance to the whole country that water should be used where there will be the least loss and where it will give the largest return in the production of crops. The great extent of territory in which irrigation is a necessity, and the hundreds of miles along water courses where it has to be distributed, make a thorough understanding of the economic problems involved in this investigation of immense importance. It is desirable that rights to streams should have an early settlement, but it is far more important that when they are settled they should have a just and equitable basis in the necessity of users, which will not only preserve the unused water supply for future generations, but also give settled conditions to present users.

We are now in the beginning of systematic irrigation in this country, and it is in the highest degree important that every inquiry which will throw light on the tendencies of present development and the direction which they should take should be made. There can be no question that the investigations thus far made by this Office and the reports published have had a marked influence on public thought in the West and have done much to reform abuses, to promote the enactment of better laws, and to lessen the waste and loss resulting from controversy and litigation.

#### FOREIGN STUDIES.

The law requires that this Office shall investigate irrigation methods and laws of foreign countries. A report on Egyptian irrigation has been published as Bulletin No. 130 of this Office. During the past year a study of the methods of operating canals and distributing water among farmers in Italy has been made. Both of these have shown that foreign countries have many ideas and practices which we can study to advantage, and these studies of foreign systems should be continued until our farmers are informed as to the methods of every country in the world where irrigation is practiced.

#### AGRICULTURAL ENGINEERING.

In my report for 1902 attention was called to the need of systematic investigations in a number of different lines embraced in the general

subject of agricultural engineering. Already it has been the policy of the Department to encourage the extension of irrigation investigations to include studies of the engineering features of drainage (with or without relation to irrigation) and the application of power to agricultural purposes generally. This policy has been approved by Congress during the past two years, as indicated by the wording of the appropriation acts. So pressing has been the demand for investigations directly relating to irrigation that it has not been possible, with the funds at the command of this Office, to do any considerable amount of work in other lines of agricultural engineering. Some studies of drainage, apart from irrigation, heretofore referred to, have been inaugurated and preliminary investigations regarding farm machinery have been instituted. Meanwhile great interest has been aroused in a number of our strongest agricultural colleges in the development of courses of instruction in farm mechanics. The increasing use of large, complicated, and expensive machinery in connection with farm operations has led to a demand on the part of the students attending the agricultural colleges for definite instruction regarding the construction and use of such machinery. Important problems regarding the further application of steam, gasoline, electricity, and other kinds of power to farm purposes are also being brought home to these institutions to solve in the interest of our farmers. The manufacturers of farm machinery, realizing that experts trained in the science and art of agriculture as well as in mechanics and engineering would make their most efficient helpers, are beginning to look to the agricultural colleges for such men. The colleges attempting to establish courses in farm mechanics and other lines of agricultural engineering are immediately made aware of the fact that the data for the scientific and pedagogical basis of such courses are very meager, and they are, therefore, looking to this Department to aid them in instituting investigations to supply this information. Since it has seemed to this Office that this field of investigation was clearly within the scope of existing law, it has begun to aid the colleges along this line. The Agricultural College of the University of Wisconsin has recently received from the State legislature funds for the equipment and maintenance of a department of farm mechanics, and an arrangement has been made by this Office with that institution, on mutually advantageous terms, for cooperative investigations on the application and use of power for agricultural purposes. With our present resources only a very limited amount of work in this line can be undertaken. There is certainly an opportunity for the Department to do a very useful service to our agricultural colleges and to our farmers by enlarging its operations in this direction, and I therefore recommend that \$10,000 be asked for to enable this Office to extend its operations in agricultural engineering, especially on the application of power to farm machinery. Inquiries which might be profitably undertaken under this head include:

(1) Preliminary work in the collection and publication of information regarding the evolution, character, and uses of farm implements and machinery in this and other countries. This is important because the available literature on the subject is scattered, fragmentary, and out of date. A small beginning has just been made in this direction in a bulletin on The Evolution of Reaping Machines, recently published by this Office, and another bulletin describing corn-harvesting machinery, which is being prepared.

(2) Laboratory and practical tests, involving a study of principles of construction and methods of operation of farm implements and machinery with special reference to efficiency and economy. These might very properly include certain strictly technical inquiries regarding the fundamental nature of the various mechanical farm operations with a view to suggesting the best means of performing them with the implements and machines at present available, or with others, the construction of which will be indicated by the results of the inquiries. Such inquiries would require considerable laboratory equipment, but the results obtained would be useful to the farmer by securing for him the most efficient implement or machine for performing the desired operation, and to the manufacturer by assisting him in the construction of the desired implements and machines.

In order that the work of this Office in lines of agricultural engineering other than irrigation may be more definitely recognized, and organized on a more permanent and satisfactory basis, I recommend that Congress be requested to change the wording of the appropriation act so as to make the general title of this division of our work "Irrigation and agricultural engineering."

#### DISTRIBUTION OF WORK IN 1903.

The character of the irrigation investigations being conducted in different States and Territories under the general supervision of Prof. Elwood Mead, chief of irrigation investigations, during the season of 1903, with the names of the agents having immediate charge of the work, is briefly outlined as follows:

CALIFORNIA.—Cooperative studies under contract with the State, under general charge of Prof. S. Fortier. Duty of water and losses from seepage and evaporation in southern California, in charge of J. A. Roadhouse, temporary agent and expert. Duty of water, losses from seepage and evaporation, and best means of remedying the same in northern California, in charge of A. P. Stover. Study of the cost and best means of pumping water in irrigation, duty of water, and effect of pumping underground supplies, in charge of Prof. J. N. Le Conte, of the University of California, assisted by A. J. Turner. Study of the effects of irrigation on the quality and market value of fruits, by Prof. E. J. Wickson, of the California experiment station.

IDAHO.—Study of the duty of water and best means of preventing excessive losses from seepage in Lost River Valley, in charge of A. E. Wright.

MONTANA.—Studies of the duty of water in Bitter Root, Gallatin, and Yellowstone valleys; effects of winter irrigation in Prickly Pear Valley and near Great Falls; studies of the quantity of water needed in irrigation and best means of applying water to crops; in charge of Prof. J. S. Baker, Bozeman, Mont. This work is being carried on in cooperation with the Montana experiment station.

NEBRASKA.—Study of water rights, duty of water and the best means of applying water to crops, in charge of Prof. O. V. P. Stout, irrigation engineer of the Nebraska experiment station; assistant, W. C. Sturdevant.



NEVADA.—Study of duty of water in irrigation and losses from seepage and evaporation, in cooperation with the Nevada experiment station, in charge of Prof. Gordon H. True.

OREGON.—Studies of the best means of applying water to crops, the duty of water in irrigation, and effects of winter irrigation, in cooperation with the Oregon experiment station, in charge of Prof. James Withycombe, Corvallis, Oreg.

SOUTH DAKOTA.—Study of irrigation from artesian wells and the best methods of application of water to crops, in cooperation with the South Dakota experiment station, in charge of Prof. A. B. Crane.

UTAH.—Measurement of the duty of water in irrigation, in cooperation with the State engineer, in charge of E. R. Morgan.

WASHINGTON.—Measurement of the quantity of water used in irrigation, and of the volume diverted from Yakima River, in charge of Prof. O. L. Waller, Pullman, Wash.; assistant, S. O. Jayne. This work is in cooperation with the Washington experiment station.

KANSAS.—Study of the cost of pumping water for irrigation, duty of water, and best means of utilizing small quantities of water in growing small fruits and vegetables, in cooperation with the Kansas experiment station, in charge of J. G. Haney.

NEW JERSEY.—Observations on the effect of irrigation in growing vegetables and small fruits, in cooperation with the New Jersey experiment station. Studies of seepage losses from ditches in sandy lands of southern New Jersey; Prof. E. B. Voorhees, New Brunswick, N. J., resident agent.

NEW ENGLAND AND MIDDLE STATES.—Study of methods of irrigating and benefits of irrigation, under direction of Prof. E. B. Voorhees, New Brunswick, N. J.

GEORGIA.—Experimental tests of the effect of underdrains in preventing erosion of hillside farms. Also study of benefits of irrigation of pastures from surface ditches and flooding; L. G. Hardman, Harmony Grove, Ga., resident agent.

SOUTH ATLANTIC STATES.—Study of improved methods of irrigating rice and truck farms.

WISCONSIN.—Studies of the best methods of irrigation in cranberry culture and duty of water in irrigation, in cooperation with the Wisconsin experiment station; Prof. A. R. Whitson, resident agent.

PLATTE RIVER DRAINAGE BASIN.—Study of irrigation laws and institutions and rights of riparian proprietors, in charge of Clarence T. Johnston, assistant chief; Dr. R. T. Ely, of the University of Wisconsin, in charge of study of economic phases of irrigation; W. B. Dunton, in charge of water-right studies; Frank Adams, in charge of the studies of the amount of water diverted and used; C. E. Tait, in charge of the studies of the amount of water returned as seepage; William Bartlett and B. P. Fleming, assistants in gauging ditches and canals and measurements of return seepage.

RICE IRRIGATION IN LOUISIANA AND TEXAS.—(a) Study of water rights of owners of irrigation pumps and canals along bayous of western Louisiana; Prof. Morton A. Aldrich, Tulane University, New

Orleans, La., temporary agent and expert; (b) Measurement of the duty of water in the irrigation of rice and tests of the cost of pumping; Prof. W. B. Gregory, Tulane University, New Orleans, La., temporary agent and expert.

#### IRRIGATION PUBLICATIONS.

The reports published during the year are as follows:

Report of Irrigation Investigations in Utah, under the direction of Elwood Mead, Chief of Irrigation Investigations, assisted by R. P. Teele, A. P. Stover, A. F. Doremus, J. D. Stannard, Frank Adams, and G. L. Swendsen. (Bulletin 124, 330 pp., 19 pls., 2 figs.)

A study of the laws and institutions relating to irrigation in Utah. Egyptian Irrigation, by Clarence T. Johnston, Assistant Chief of Irrigation Investigations. (Bulletin 130, 100 pp., 24 pls., 9 figs.)

This is a study of the irrigation laws and practices of Egypt, made with special reference to suggestions for improvements in American irrigation.

Plans of Structures in Use on Irrigation Canals in the United States, prepared under the direction of Elwood Mead, Chief of Irrigation Investigations. (Bulletin 131, 51 pp., 22 pls.)

This is an album of plans for irrigation structures, designed by leading irrigation engineers of the West, made from drawings exhibited at Paris in 1900 and at Buffalo in 1901.

Report of Irrigation Investigations for 1902, under the direction of Elwood Mead, Chief of Irrigation Investigations, containing the following reports: Irrigation in the Mountain Water District of Salt Lake County, Utah, by E. R. Morgan; The Use of Water from the Wood Rivers, Idaho, by J. D. Stannard; Irrigation Investigations on Sand Creek, Albany County, Wyo., by B. P. Fleming; Irrigation in Washington, by O. L. Waller; Irrigation Investigations in Montana, by Samuel Fortier; Irrigation Systems on Stoney Creek, California, by W. T. Clarke and C. W. Landis; Irrigation in the Black Hills, South Dakota, by A. B. Crane; Rice Irrigation in Louisiana and Texas, by Frank Bond; Third Progress Report on Silt Measurements, by J. C. Nagle; Irrigation Experiments at the Missouri Experiment Station, by H. J. Waters; Irrigation in Wisconsin in 1902, by A. R. Whitson; Irrigation Investigations in New Jersey, 1902, by E. B. Voorhees; Use of Pumps for Irrigation in Hawaii, by Jared G. Smith. (Bulletin 133, 265 pp., 12 pls., 16 figs.)

Storage of Water on Cache la Poudre and Big Thompson Rivers, by C. E. Tait, assistant in Irrigation Investigations. (Bulletin 134, 100 pp., 5 pls., 10 figs.)

This bulletin gives details of areas, capacities, and construction of reservoirs in northern Colorado and the profits from their use.

Some Engineering Features of Drainage, by C. G. Elliott, Drainage Expert. (Yearbook, 1902, pp. 231-244, 1 pl., 2 figs.)

This is a brief discussion of some general features of drainage and a description of some drainage works near Greeley, Colo.

Review of Irrigation Investigations for 1902, by Elwood Mead. (Annual Report Office of Experiment Stations, 1902, pp. 359-385, pls. 6.)

## REPORT OF THE DIRECTOR OF THE OFFICE OF PUBLIC ROAD INQUIRIES.

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U. S. DEPARTMENT OF AGRICULTURE,  
OFFICE OF PUBLIC ROAD INQUIRIES,  
*Washington, D. C., September 9, 1903.*

SIR: I have the honor to submit herewith the report of the Office of Public Road Inquiries for the fiscal year ending June 30, 1903, together with an outline of the work for the current year and recommendations and estimates for the ensuing year.

Respectfully,

MARTIN DODGE, *Director.*

Hon. JAMES WILSON, *Secretary.*

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### WORK OF THE YEAR.

During the fiscal year 1902-1903 the work of this Office has been continued and extended along the lines laid down in previous reports. The Director and his assistants, including the office force, special agents, and road experts, have been engaged in collecting and disseminating valuable information relating to the road question. The Office is now considered headquarters for information on all phases of the road subject, and its correspondence is therefore becoming more extensive each year.

Never before in the history of the country has there been so much attention paid to the improvement of the public highways as in the last year. State and local road associations are being organized in all parts of the country, and numerous meetings have been held at which the subject of road improvement was under discussion. The officials of this Office have attended as many of these meetings as possible, where they have given advice and information on road building. The object-lesson and experimental road work has been greatly extended. The importance of this practical feature of the work has been fully demonstrated, and the demands for its further extension are constantly increasing, the Office being almost daily in receipt of communications on this subject. Owing to limited resources, the Office has heretofore been unable to carry on this object-lesson road work in more than one place at the same time, but during the past year it has been carried on in three different States at the same time.

### PUBLICATIONS OF THE OFFICE.

During the year four important publications were issued, three of which relate to the work done in the Southern States during the winter of 1901-1902 in cooperation with the National Good Roads Association and the Southern Railway Company.



Bulletin No. 23 contains a general report of the conventions held in connection with this expedition and an outline of the practical work accomplished in the way of object-lesson road building, including reports and abstracts of many of the speeches and addresses delivered.

Bulletin No. 24 contains the proceedings of the convention held at Raleigh, N. C., in which this Office cooperated with the National Good Roads Association and the Southern Railway Company. The number and representative character of those attending this meeting and the instructive addresses delivered made it one of the most important conventions held during the itinerary of the Southern Railway good roads train.

Bulletin No. 25 contains the proceedings of the Jefferson Memorial and Interstate Good Roads Convention, held at Charlottesville, Va., April 2, 3, and 4, 1902. This was the last of this series of conventions, and was one of the greatest and most successful meetings ever held in the country for the consideration of highway improvement. Its National scope was shown by the fact that fifteen States were represented, including Maine, Oregon, and Florida. The convention was addressed by governors, Members of Congress, general officers of the United States Army, the Assistant Secretary of Agriculture, presidents of universities and railway companies, and others. The bulletin contains many valuable addresses and much information relating to highway improvement which will be of interest throughout the United States.

In connection with the opening of the Louisiana Purchase Exposition, a National good roads convention was held at St. Louis, Mo., April 27 to 29, 1903. This convention was largely attended, most of the States and Territories being represented. Among the distinguished speakers who delivered addresses were Hon. Theodore Roosevelt, President of the United States; Hon. William J. Bryan, of Nebraska; General Miles, of the U. S. Army; Governor Dockery, of Missouri; Governor Cummins, of Iowa; Hon. A. C. Latimer, United States Senator from South Carolina; Hon. W. D. Vandiver, Member of Congress from Missouri; Hon. D. R. Francis, president of the Louisiana Purchase Exposition committee; Hon. J. H. Brigham, Assistant Secretary of Agriculture; Gen. Roy Stone, of New York, and Mr. Samuel Hill, of Washington. Addresses were also delivered by prominent men engaged in agriculture, railway transportation, commercial pursuits, and newspaper work. The speakers dealt mainly with methods and materials for building and improving the common roads, the methods of raising funds to pay the expenses of such work, and the needed legislation. The report of this convention, prepared as Bulletin No. 26 of this Office, is now in press, and it is believed that it will greatly help to advance the cause of road improvement throughout the country.

Nearly all of the leading publications of the Office have been reprinted during the past year, and the demands for literature on this subject are constantly increasing.

#### WORK OF SPECIAL AGENTS OF THE OFFICE.

During the year Prof. J. A. Holmes, of Chapelhill, N. C., continued to represent the Office as special agent in charge of the Southern division, and Mr. James W. Abbott, of Denver, Colo., represented the Office as special agent for the Rocky Mountain and Pacific Coast

division. The increase in appropriation made it possible to appoint two new special agents, one to represent the Office in the Middle Western division, and the other in the Central division. Mr. R. W. Richardson, of Omaha, Nebr., was appointed special agent in charge of the Middle Western division, while Mr. Jay F. Brown, of Cleveland, Ohio, was appointed as special agent for the Central division. Summaries of the work of these special agents for the fiscal year ending June 30, 1903, are submitted.

#### SOUTHERN DIVISION.

In the Southern division, embracing Maryland, the two Virginias, the two Carolinas, Georgia, Alabama, Mississippi, Louisiana, Texas, Arkansas, Tennessee, Kentucky, and in Oklahoma and Indian Territory the work has been carried on by Professor Holmes, with headquarters at Chapelhill, N. C. At intervals during the year most of these States have been visited by the special agent, who has delivered a number of addresses before public meetings, and has aided in the revision of road laws in several of the States and in the enactment of more satisfactory legislation for highway improvement.

The special agent has also aided in this work by carrying on an extensive correspondence with the local road supervisors and persons interested in road improvement in the various counties of the several Southern States. He has contributed for publication in papers published in these States a number of articles relating to road improvement, and has, with the aid of Mr. R. H. Sykes, of the North Carolina geological survey, prepared and published during the year 28 special press bulletins containing short articles for reproduction in the various journals and newspapers of the Southern States. These articles have been extensively reproduced, and have contributed much toward the awakening and upbuilding of a new interest in the work of road improvement in each of these States.

Mr. W. L. Spoon, the road expert employed in the Southern division during the past year, under the supervision of Professor Holmes, and through the cooperation of the North Carolina geological survey, has during the year carried on in eastern North Carolina, South Carolina, and Virginia numerous experiments in connection with the improvement of earth roads, and especially the construction of sand-clay roads in portions of these States. He has visited more than a dozen counties in the Coastal Plain regions of these States, and has there made a number of experiments with a view to determining the proportions in which the sand and clay found in the counties should be combined to produce the best results. These experiments have been in conjunction with the county and State authorities, who have been shown how to conduct this work in the most practical way, and it is proposed to continue the experiments in methods of building sand and clay roads.

In the Southern division the interest in public road improvement is steadily increasing, this being due largely to the educational work of the Office of Public Road Inquiries. This popular interest will result in permanent betterment of the roads and highways, as the experiments show that road improvement can be secured at a cost so moderate as to permit its being carried forward on an increasingly larger and more thorough scale.

## CENTRAL DIVISION.

During the year Mr. Brown has been engaged in local work in northern Ohio, responding to numerous calls for information as to the kind of material and the manner of using it in making improved roads. He has made plans and specifications for building object-lesson roads, as follows: One at Leroy, in Medina County; one at Dover, in Cuyahoga County; one at Kirtland, in Lake County; and one in Russell Township, in Geauga County—all in northern Ohio. In some cases where local engineering talent was not available Mr. Brown has personally used transit and level to secure good alignment and grades of new roads, has made frequent trips to these roads while under construction, and has closely observed the material and the work, and advised the men employed. Much interest has been aroused by the building of these object-lesson roads, and the correspondence arising therefrom is constantly increasing. The following are some of the details of construction of these object-lesson roads:

**LEROY ROAD.**—This road is in Medina County, Ohio. It was constructed of granite bowlders, an abundant supply of these being found in the neighborhood. The machinery used was a Champion rock crusher and two dump wagons for distributing stone, one 12-ton steam roller, and one sprinkler. The width of stone road is 12 feet and the thickness 10 inches. First course of stone,  $2\frac{1}{2}$ -inch size, laid in one course 10 inches deep, after rolling  $7\frac{1}{2}$  inches deep. Second course,  $1\frac{1}{2}$ -inch size, 3 inches deep, after rolling  $2\frac{1}{2}$  inches deep. Top course, screenings,  $\frac{1}{2}$ -inch. All voids filled with fine silicate gravel or rock dust, rolled first dry and then wet until solidified. Quantity of material per rod, 12 tons. Length built, 2,100 feet. Cost, including amount paid Government employees, \$2,480 per mile.

**BRUNSWICK ROAD.**—This road, in Brunswick Township, Medina County, Ohio, was commenced July 10, 1902, and finished August 25, 1902. Material used, conglomerate gravel, of which the supply is abundant. Machinery, same as at Leroy, except that crusher was not needed. Width of road 9 feet, and depth 15 inches. Three courses, each 5 inches thick, were laid, and each rolled separately. Quantity of material per rod,  $13\frac{1}{2}$  tons. Length built, 1,700 feet. Approximate cost, including wages of Government employees, \$1,728 per mile.

**DOVER ROAD.**—This road, in Dover Township, Cuyahoga County, Ohio, was begun September 1, 1902, and finished October 20, 1902. The material used was sandstone for bottom course and crushed granite bowlders for upper part, the supply of material being good. Machinery, same as at Leroy. Width of road 9 feet, and thickness 10 inches, including 4 inches of sandstone base rolled to a solid bearing. Second course, crushed granite bowlders,  $2\frac{1}{2}$ -inch size; after rolling,  $4\frac{1}{2}$  inches deep. Next course  $1\frac{1}{2}$ -inch size, crushed bowlders;  $2\frac{1}{2}$  inches deep after rolling. Top course, screenings and small stones,  $1\frac{1}{2}$  inches deep after rolling. Quantity of material per rod, 9 tons. Length built, three-fourths of a mile. Approximate cost, \$2,878 per mile, including wages paid Government employees.

**KIRTLAND ROAD.**—This road, at Kirtland, Lake County, Ohio, was begun May 4, 1903, and finished June 2, 1903. Material used, sandstone for base and crushed granite bowlders for top; supply very abundant. Same construction as Dover road. Quantity of material



used, 9 tons per rod. Width, 9 feet. Length built, 1,645 feet. Cost, \$1,728 per mile, including wages of Government employees.

**RUSSELL ROAD.**—This road, located in Russell Township, Geauga County, Ohio, was begun June 3, 1903, and finished August 4, 1903. Material used, sandstone for base and crushed granite boulders for top; supply abundant. Machinery, same as at Leroy. Width, 9 feet; thickness, 10 inches. Construction same as at Dover and Kirtland, except that the course of 2½-inch stone was spread in two courses and rolled separately, which seems to be an advantage in securing a better grade line. Quantity of material used, 9 tons per rod. Length built, 1 mile. Cost of construction per mile, \$2,800, to which should be added for wages of Government employees \$510, making a total of \$3,310. A considerable amount of grading on this road made the cost greater than that of the other roads.

Much credit is due to the well-organized force of Government employees engaged in building these object-lesson roads under the direction of Mr. J. H. Dodge, by whose efforts excellent results have been obtained. Considerable work of this kind is in prospect for the coming year, and many inquiries are being made as to cost of object-lesson roads. Mr. Brown has made a study of road materials with a view to making use of the local material nearest at hand. Each locality has some special material to be investigated. Many kinds of gravel and rocks have, therefore, been sent in by him to be tested for wearing power and adaptability for surfacing roads. The object-lesson road at Brunswick, built of quartz gravel, as an experiment to start with, now appears to be a good hard road, well bonded, and will doubtless serve as a model for more roads of the same construction, there being a plentiful supply of the gravel in that locality. The use of crushed granite boulders for the wearing surface is a success, as it makes a smooth, hard surface. Mr. Brown has often substituted for the lower course common field or creek stones as a foundation, when they are to be had close to the work, and thoroughly consolidated them by rolling. He has also devised a foundation course of common stone, broken to 2½-inch size and thoroughly compacted, for an ordinary gravel road. This prevents the gravel from cutting through in bad weather, the gravel being put on in courses not more than 3 inches deep and thoroughly wet, rolled to a solid mass. Mr. Brown is making an investigation of the limestones of northern Ohio, and a statement of the results will appear in the next report.

#### MIDDLE WESTERN DIVISION.

Mr. R. W. Richardson, of Omaha, Nebr., took charge of the work as special agent of the Middle Western division of this Office on July 1, 1902. His first work was at St. Paul, Minn., negotiating with the Great Northern Railway for a "good roads train" to be operated over that system during the fall. These negotiations were successful, and the first good-roads convention on this expedition was held on the grounds of the Minnesota State Fair, at St. Paul, September 1 to 5, 1902. An object-lesson road was also built by the experts accompanying the good-roads train to illustrate proper methods of using local materials. Mr. Richardson also completed the arrangements for the itinerary of the train and for the holding of conventions and the building of object-lesson roads in connection therewith at St. Cloud.

Minn., September 8 to 13; Fargo, N. Dak., September 15 to 20, and Grand Forks, N. Dak., September 22 to 27.

The following State conventions were held later: For the State of Washington, at Seattle, October 6 to 12; for Oregon, at Portland, October 13 to 20, and for Idaho, at Boise, October 23 to 25, 1902. The conventions held in these States have resulted in marked activity toward permanent road improvement, and have also led to the amendment of road laws in those States.

During the month of November Mr. Richardson participated in a successful State convention held at Lexington, Ky. In January, 1903, he completed arrangements for and participated in a State good-roads convention at Little Rock, Ark. More than a thousand delegates were present, and every county in the State was represented. A State association was organized and a modern State-aid law was prepared and submitted to the legislature. It was too late in the session to hope for its adoption, but it was favorably received throughout the State and it has almost a sure promise of becoming a law at the next session. Mr. Richardson, as well as Special Agent Abbott and Assistant Director Eldridge, attended and participated in a State convention held in Dallas, Tex., in March. A State good-roads association was formed and the foundation work for public road improvement in Texas was actively begun.

In April, 1903, Governor Cummins, of Iowa, issued a proclamation calling a representative convention for the consideration of the subject of improved roads in that State. Mr. Richardson, Mr. Abbott, and Mr. Eldridge also participated in that convention, which met in Des Moines April 16. Three hundred and fifty delegates were present, representing every county in the State, and the subject of road improvement was thoroughly and practically considered. A new State association was organized and an active campaign was entered upon. As a direct result of this convention both political parties at their recent State conventions adopted planks in their platforms demanding from the next general assembly modern legislation embodying the principles of State aid.

Upon request of the good-roads committee of the Illinois legislature, Mr. Richardson also gave valuable assistance in the preparation of the Reese bill, which was enacted into law and which provided for a State commission to make inquiry as to road conditions and to prepare and submit a modern plan of road legislation to the next general assembly. He also gave advice in reference to the convict-labor bill, which was then under discussion, and which has since become a law. This bill provides for the use of convicts in the preparation of road materials in the quarries located on the grounds of penal institutions, and that it shall be donated to the counties free of cost.

In addition to the above, Special Agent Richardson participated in the National Good Roads Convention held in St. Louis, Mo., April 27 to 29, and also attended and addressed a number of smaller conventions in different parts of his territory. He has rendered valuable service to the people of the Middle West in organizing conventions and in promoting in many other ways the improvement of highways.

ROCKY MOUNTAIN AND PACIFIC COAST DIVISION.

Mr. James W. Abbott, who is still an ardent enthusiast in the good-roads cause, devoted nearly the entire year to it, although for the last seven months there were no funds available to pay for his services.

In the early part of the year he assisted in the Northwestern campaign already referred to, helping to make the arrangements, accompanying the Great Northern good roads train, supervising the engineering work for the sample roads, delivering illustrated addresses at the conventions, and striving in all feasible ways to promote its success. After the Boise convention, October 23, 1903, he returned to Oregon and Washington, where he visited many counties, conferring with road supervisors and other principal citizens, advising them in road matters, and furnishing much material for the local press. He made a trip through California, studying further the oiled roads, and wrote a paper on the "Use of oil in road improvement," which was published in the Yearbook of this Department for 1902, and also issued in pamphlet form. Later he attended and participated in good-roads conventions at Dallas, Tex., St. Louis, Mo., and Pueblo, Colo.

During the year Mr. Abbott visited many points in Colorado and Arizona, working along the same lines as in previous years. He contributed much to the press of the country, including a very carefully prepared and valuable technical paper on "Roads for mines," which was published in the Engineering and Mining Journal, of New York, and many articles, some elaborately illustrated, for magazines and metropolitan dailies, besides a very large number of dictated interviews.

During the year Mr. Abbott was called upon to give technical advice regarding the location and construction of very many roads, and he made a special effort to respond to as many as possible of these calls.

#### ROAD-MATERIAL LABORATORY.

The officials of the road-material laboratory, established in December, 1900, in the Bureau of Chemistry, in collaboration with this Office, have continued to study and test road materials from different parts of the country. The laboratory is now equipped with the necessary apparatus for determining the quality of materials used in road improvement, some new apparatus having been secured during the past year. Rocks for road building are subjected to an abrasion test to determine their resistance to wear, a cementation test to determine their cementing or binding power, a toughness test, and a hardness test.

Any person residing in the United States may have materials tested free of charge by applying for instructions and blank forms to the Office of Public Road Inquiries or to the road-material laboratory, Bureau of Chemistry. Besides testing road materials, blank forms for recording traffic are supplied by the Department to anyone intending to build a road. When these forms are filled and returned to the laboratory, together with samples of materials available for building the road, the traffic of the road is rated, each property of the material is tested and similarly rated according to its degree, the climatic conditions are considered, and expert advice is given as to the proper choice of material to be made.

#### NATIONAL SCHOOL FOR ROAD BUILDING.

Public sentiment in favor of better roads has grown so rapidly within the last few years that a number of the Eastern States, and many counties, parishes, townships, towns, and districts in the Central, Southern, and Western States, have raised sufficient funds to improve



some of the leading highways. In many of the Southern and Western States these funds are being injudiciously expended on account of a lack of intelligent and skilled supervision. This Office is being constantly appealed to for experts and engineers skilled in the art of road building to take permanent charge of State and county work, and the demand for such men far exceeds the supply. Several of the technical colleges of the country are turning out each year a large number of civil engineers, but most of them know little or nothing about practical road building. It would therefore seem advisable that in connection with the Office of Public Road Inquiries there should be established in Washington a post-graduate school, where graduates in civil engineering from the land-grant colleges could secure a thorough course in theoretical and practical road building. A similar school was established in Paris by the Government of France in the year 1747, and the condition of French roads to-day attests the wisdom of such action. The American school of road building should include a series of lectures by experts of this Office, and some practical work in the road-material laboratory and in connection with the object-lesson road work of the Office in different parts of the country.

#### GOVERNMENT COOPERATION IN OBJECT-LESSON AND EXPERIMENTAL ROAD BUILDING.

It is noticeable that communities with good roads have a higher appreciation of the value of such roads than communities lacking them. It is also noticeable that wherever good road building has been begun it has generally continued to spread over the adjacent area until limited by a lack of suitable local materials or of a sufficient revenue to carry on the work. People who have once had the benefit of good roads are always in favor of extending the same to other communities; and people who have not been blessed with these advantages seldom appreciate their value until they have been brought in contact in some way with such roads, or at least samples of them. Often people of the latter class will oppose all attempts to improve the highways because of their lack of appreciation of the advantages that will result therefrom, but they almost always change their minds when the improvement has been made in spite of their opposition. This is abundantly illustrated by the case of Capt. S. B. Alexander, author of the famous Mecklenburg road law of North Carolina. When a member of the legislature of that State, in 1878, he introduced a bill which afterwards became a law, providing for a general tax upon the property of the entire county, both city and country, the proceeds of which were to be devoted to the permanent improvement of the roads in Mecklenburg County. The people who had elected Captain Alexander to the legislature were so much displeased at this action that he was defeated at the next election, and his successor in office was elected to effect a repeal of the "obnoxious" law. This was done. The law was in force long enough, however, to produce a few miles of good road in the county, which served as an object lesson to educate the people. By the time another two years had elapsed and a new legislature was to be chosen Captain Alexander was reelected, with instructions to secure the reenactment of the original law. The law has now been in effect for many years, being of great advantage to the people and producing a transformation of the entire county. The law and its author

have both become famous. Captain Alexander was elected to Congress, and the Mecklenburg road law is regarded as a model of road legislation in the entire country, especially in the Southern States. One may travel a thousand miles in a southwesterly direction from Washington without seeing an improved highway except in Mecklenburg County; but as soon as the boundaries of that county are reached, any passenger can tell where he is by the excellent appearance of the highways and the advanced condition of agriculture. This is only one of many instances that could be given, but it is the best to illustrate the general rule.

#### PLAN OF GOVERNMENT COOPERATION.

Fully believing in the beneficial results that follow object-lesson teaching, not only in institutions of learning, but in the progress of the world, the Director of the Office of Public Road Inquiries undertook to demonstrate the benefits resulting from this method by building object-lesson roads in different parts of the country. The work was undertaken on the principle of cooperation in the following manner: This Office furnishes the plans, specifications, scientific information, instructions, expert road builders, didactic literature, and all the machinery required in the construction of the road, and provides for testing all road-building material in the laboratory at Washington, D. C. The communities having the road built are required to furnish all necessary materials and common labor.

#### EARLY COOPERATIVE WORK AND ITS INFLUENCE.

MARYLAND.—The first work undertaken by the Office after the appointment of the present Director was in Baltimore County, Md., an excellent description of which is contained in the following letter from Mr. Walter P. Reckord, under date of June 28, 1902:

The object-lesson road built by your Department has been seed sown in good soil. I think it was the first object-lesson road built in Maryland, and it has proven a great and good lesson to our people. I am sure no other plan could teach the road officials of our State so valuable a lesson in so short a time. The road was built in a much-traveled section between Fork and Bradshaw, Baltimore County, where much heavy hauling is done, as much as 5 tons being carried upon one wagon with a 3½-inch tire. It was built by your Office and abandoned by the road mender to go down. While in construction there was held a State "good-roads day," July 30, 1898. Since then not one cent has been put upon it, not even to clean out the side drains nor pick up the few loose stones brought to the surface by constant wear and hard rains. Few persons expected it to be permanent, as your road engineer, the late Mr. E. G. Harrison, used only about 8 inches of stone, while the road previously built was from 14 to 24 inches. It was watched by those interested in good roads, and when they found that it stood the test our people began imitating it. While many of the roads are not constructed entirely upon your plans, they are greatly improved over the old system used before you built the object-lesson road. I feel that the building of this road and the good-roads convention held had a great deal to do with bringing about our present good-roads law in Baltimore County.

MICHIGAN.—The next work was near Port Huron, Mich., beginning July 2, 1900, where was built a half mile of macadam road adjacent to that city. The condition of this road two years after its construction and the results therefrom are well set forth in a letter from Mr. Frank F. Rogers, consulting engineer of the highway committee for the State of Michigan, as follows:

On the whole, the road has been a decided success and a surprise to its most earnest advocates. It has sustained all the travel which formerly was divided between the two sides of the street railroad, and maintained a splendid surface with very slight repairs.

The soil was considered a difficult one on which to build and maintain a road. The drainage is imperfect; open side ditches were the only kind of drains that could be used, and the ground is so level, and the outlets so poor, that they are frequently partially filled with water for several weeks at a time. The soil is a sandy loam underlaid with quicksand.

Previous to the building of this road no well-built macadam road existed in this locality, except a few city streets, which were built entirely of limestone from the various Michigan quarries. They are so dusty as to be intolerable without frequent sprinkling. On this road crushed cobblestones were used for the top course, and the experiment has fully demonstrated that this is the only fit material for the wearing course, wherever cobblestones can be had at a cost of less than \$6 per cord. They make roads as free from dust as the best gravel, and possess a much better wearing surface.

We now have over 3 miles of well-built macadam roads in Port Huron Township, the result of the enthusiasm developed on account of the sample road. This is being added to every year, and in time we hope to have every main road in Port Huron Township well macadamized.

Other parts of the State are taking up the work. Grosse Pointe Township of Wayne County is spending \$176,000 for macadam roads. Saginaw County has secured a special road law, and will soon begin to construct a system of roads that will eventually include every main traveled road in the county.

It seems within the bounds of proof to state that, as a direct result of the good work done at Port Huron, Saginaw, and Traverse City, a thorough awakening to the needs of better roads has been accomplished, and the good-roads cause in Michigan has received such an impetus that it will never be quitted until a suitable good-roads law has been enacted for this State.

It is a pleasure to be able to make so good a report of the work you have accomplished in Michigan.

Near Saginaw, Mich., the longest piece of object-lesson road ever built in any one place by the Office of Public Road Inquiries was constructed, it being nearly 2 miles in length, and as a direct result of this work, the special law above referred to by Mr. Rogers was enacted by the legislature, and the county of Saginaw voted to expend \$60,000 during the present year for the permanent improvement of its roads, and a like amount is to be expended each year. This new work was inaugurated on June 19, 1902, at a great meeting held in the city of Saginaw, after which a grand procession marched through the city about 2 miles out to the road where the actual work was begun. This procession was headed by the governor of Michigan and his staff, and the mayor and police force of Saginaw. Ground was broken for the new work by the governor. Governor Bliss, of Michigan, therefore, has the credit of being the first governor to put his hands to the plow in this new and great work of road building by cooperation. The city of Saginaw, the county of Saginaw, the State of Michigan, and the United States Government were all represented at this meeting, and they all cooperated in producing the result.

Later in the season of 1900 a third road was built in the northern peninsula of Michigan, near Traverse City, and the following extract from a letter written by the Hon. Frank Hamilton, two years after the construction of the road, shows some of the beneficial results of the work there:

The road built under your supervision has given universal satisfaction, and many people have visited here to see the possibilities in public-road building. The whole country has been stimulated to improve the old roads. It is very apparent that good roads can be built in sections where gravel and clay abound. The main object is to educate the people how best to use the material at hand. During our convention here 13 counties were represented, and the good seed was sown broadcast. That it is daily bearing good fruit we are confident.

KANSAS.—During the same year (1900) another object-lesson road was built near Topeka, Kans., a report on which is contained in the



following letter, dated August 29, 1902, from Mr. Robert Stone, of Topeka:

The results following from this example and from the good-roads convention that was held here at that time have been far-reaching. As a direct result, we obtained a general good-roads law at the next session of the legislature which authorizes any county in the State to levy a tax for road building under the supervision of the county commissioners in connection with the officers of the township. A special law was also passed for this county, and under that law our county commissioners levied a tax last year of half a mill, from which they realized about \$8,000, which has been expended in the purchase of good-roads machinery and the laying of about 2 miles of good road this season. They have just made a levy for the ensuing year of eight-tenths of a mill, from which they will probably realize \$14,000 or \$15,000, and they are about to contract for the laying of another mile of road, 20 feet wide, after the most approved manner. The movement has started here in this State and we believe that it will continue.

PENNSYLVANIA.—The last object-lesson work done in 1900 was at Canonsburg, Pa., under the supervision of Mr. M. O. Eldridge, the assistant director of the Office. A good report of the work is found in the following from the Canonsburg Notes:

Nearly two years ago a mile or more of road in this township was macadamized in a scientific manner under the direction of Government experts and with machinery furnished by the National Government, which at the time was commented upon by road makers everywhere. It will be of interest to all farmers of the county and elsewhere to learn what is now the condition of this piece of road, and what the persons who travel over it think of it. For the benefit of all persons who may be interested in this experiment, as it may be called, I will, from my own personal observations, state that this road is in excellent condition, *as good in every respect as on the date of its completion*, and from all appearances it will remain in the same first-class condition for years to come, although nearly every day of the year heavily loaded wagons pass over it.

I wish to state that, although at the time this sample road was built many land-owners in this section were not in sympathy with the movement, after two years' travel over the road they have changed their minds and now favor the plan of constructing a reasonable amount of similar road each year until all important thoroughfares of North Strabane Township shall have been improved.

The sample road is here to speak for itself, and it is well worth any farmer's time to come even from a remote part of the county to see for himself what a good road is after it has demonstrated its durability.

#### EXPANSION OF OBJECT-LESSON WORK.

##### ILLINOIS CENTRAL GOOD ROADS TRAIN.

Being encouraged by the beneficial results of the object-lesson roads previously built, the Office undertook in 1901 a more extensive expedition in cooperation with the National Good Roads Association and the Illinois Central Railway Company, building object-lesson roads in Louisiana, Mississippi, Tennessee, Kentucky, and Illinois. The good roads train, which was furnished free by the Illinois Central Railway Company, consisted of nine cars loaded with modern roadmaking machinery, together with a commissary and a special officers' car, carrying the Director of the Office of Public Road Inquiries, the president, secretary, and civil engineer of the National Good Roads Association, a special Government engineer and expert, six road-machinery experts, a special agent in charge of the machinery, a member of the Associated Press, cooks, porter, and laborers. The result of this expedition is well illustrated by the remarks of the Hon. A. H. Longino, governor of Mississippi, at the International Good Roads Congress, held at Buffalo, N. Y., September 16 to 21, 1901, as follows:

I live in a section of the country where this important subject has found at the hands of the people apparently less appreciation and less effort toward improvement

than in many others. In behalf of the good roads association which recently met in the State of Mississippi, I want to say that more interest has been aroused by their efforts concerning this important subject among the people there than perhaps ever existed before in the history of the State. By their work, demonstrating what could be done by the methods which they employed, and by their agitation of the question, the people have become aroused as they never were before, and since their departure from the State a large number of counties which were not already working under the contract system have provided for public highways, worked by contract, requiring the contractor to give a good and sufficient bond—a bond broad enough in its provision and large enough in amount to compel faithful service; and Mississippi is to-day starting out on a higher plane than ever before.

#### THE SOUTHERN RAILWAY GOOD ROADS TRAIN.

Almost immediately after the great International Good Roads Congress at Buffalo, N. Y., another good roads expedition was started over the Southern Railway, the train and equipment being furnished free by the Southern Railway Company, and the cooperating forces being the same as those engaged upon the Illinois Central expedition.

This good roads train left Alexandria, Va., Tuesday afternoon, October 29, 1901, and was steadily at work until Saturday, December 21, 1901, when it was laid up for Christmas holidays. It started out again on January 9 and continued its work until April 5, 1902. Two weeks were lost in February on account of inclement weather. In all, the time devoted to the work was over five months. The train carried two of the Southern Railway officers' cars, a camp car, and from 10 to 12 carloads of modern road-making machinery. Accompanying the train were the Director, assistant director, and other representatives of the Office of Public Road Inquiries, Washington, D. C.; President W. H. Moore and Secretary R. W. Richardson of the National Good Roads Association; Mr. M. A. Hays, agent of the land and industrial department of the Southern Railway; Mr. C. M. Scott, representing the allied machinery interests, and representatives and operators of road-machinery companies.

The itinerary of the train included the following States: Virginia, North Carolina, South Carolina, Georgia, Alabama, and Tennessee. During its journey the train traveled 4,037 miles. Sample roads were constructed and conventions held at 18 places. The total length of completed road made was from 12 to 15 miles, and includes samples made of earth, gravel, sand and clay, chert, shell, and macadam. The conventions lasted from one to three days each, and were participated in by large numbers of people. Of these conventions, five were State conventions, two were general, and the rest district conventions. Five State and five district good roads associations were organized to carry on active work in creating sentiment for highway improvement. The officers of these associations are representative citizens, well fitted to head such a movement. General interest was displayed in the progress of the train and in the conventions held, and a great sentiment was created throughout the South in favor of road improvement. The addresses at the conventions were usually of a high order. Among those participating were the governors of the States, United States Senators and Representatives, other public officials, heads of universities, colleges, and agricultural schools, railroad officials, business men, and farmers. In some of the States, before the arrival of the train, the governors issued proclamations calling attention to its coming and to the conventions to be held, and urging the people to take an interest in the movement. In some States the governors appointed

delegates from every county, thus giving the work the direct indorsement of the State governments. During the progress of the train annual messages of the governors, delivered to legislatures in session, were devoted, in part, to the good roads movement.

The places where the train stopped for object-lesson work were Winston-Salem, N. C.; Asheville, N. C.; Greeneville, Tenn.; Chattanooga, Tenn.; Birmingham, Ala.; Mobile, Ala.; Montgomery, Ala.; Atlanta, Ga.; Greenville, S. C.; Columbus, Ga.; Augusta, Ga.; Columbia, S. C.; Charleston, S. C.; Raleigh, N. C.; Lynchburg, Va.; Danville, Va.; Richmond, Va., and Charlottesville, Va.

In connection with the arrival of the good-roads train at Lynchburg, Va., in March, 1902, Hon. John W. Daniel, United States Senator from Virginia, said:

An itinerant college on wheels has come among us. It brings its professors and its equipment with it. It is known as the "good roads train" of the Southern Railway system. This college does not teach out of books, nor solely by word of mouth. It teaches by the greater power of example. If you will just watch its operation you will see a new good road grow over an old and bad road at the magic touch of titanic machinery, and while an orator talks of road building it will set his words to the music of practical accomplishment.

The United States is here with its good roads promoter and its rural free-delivery representatives to give suggestions and encouragement. The United States is pretty much everywhere. It is a good friend and uncomfortable enemy, and I hope we shall always be ready to accept its good friendship and cooperation. Indeed, we are a right considerable part of the United States ourselves, and we want to do our share of duty to the Republic and receive our share of the benefits. We give hearty welcome to its representatives.

When a child I stood on the old stone wall which still overlooks the union depot here and saw Governor Floyd strike the first pick in the ground for the beginning of the Virginia and Tennessee Railroad. Recently I have gotten on a Pullman car here and taken a journey to San Francisco and back, scarcely touching the ground going or coming.

Here and now we behold the initiation of another new movement, a movement for good local roads, and many who witness these exercises will live, I hope, to see them constructed and to enjoy the pleasures and benefits which they will bring.

A good road is a universal public benefaction. There is not a single member of the community who does not receive advantage and pleasure from it. It is the most democratic of all public institutions. A court-house is for litigants, an asylum is for the infirm, a jail for criminals, a theater for entertainment, a park for recreation, a school for instruction, a church for worshipers, a hotel for wayfarers, but a good road is for everybody—saint and sinner, man, woman, and child, maid and matron, young and old, rich and poor, healthy and sick, the lame, the halt, and the blind—all get a share of benefit from a good road.

Many gratifying reports have been received from all parts of the South showing the beneficial results following this great good-roads expedition, some of which are submitted as follows:

*W. L. Spoon, special agent, Goldsboro, N. C., October 6, 1902:* I was at Winston, N. C., last week and went up to see the first piece of work done by the good roads train, and I am delighted with its excellent condition. It is as fine as any road in North Carolina to-day. It has been extended for nearly 1 mile. I have no doubt you will be delighted to know this.

*S. L. Patterson, North Carolina commissioner of agriculture and immigration, Raleigh, N. C.:* It gives me pleasure to say that the increased interest in building and maintaining good roads has been very marked in North Carolina since the visit of the good roads train. Though little actual work has been done, yet from all sections of the State, especially from those sections where the good roads train stopped and conventions were held, numerous inquiries have come to me for information and for copies of the recent road laws passed by our legislature, the adoption of which is optional with the county commissioners. Other evidence of various kinds shows the awakening of our people to the great necessity of road improvement. I am sure of the great value of the work your Office has undertaken, and I wish you continued success.



*W. L. Spoon, special agent, Burlington, N. C., December 16, 1902:* It affords me great pleasure to be able to report that the object lesson road built at Raleigh under the direction of your Office is in excellent condition. The work, as you will remember, was seriously interrupted by the severity of the weather, and had to be left partially incomplete. But it shows excellent construction in the foundation, as is evidenced by the fact that the very heavy traffic it daily bears does not wear the surface into holes or uneven places.

Aside from its value to Raleigh as an excellent piece of macadam street, probably its greatest value was the "object lesson" it furnished the visiting delegates from the various counties who were present and saw the actual work of constructing a macadam road upon sound, scientific principles. Many of the visiting delegates never saw a macadam road and knew positively nothing about them. But at Raleigh they saw the actual work—the grading and preparation of the foundation; the rolling of the foundation until it was firm and smooth, and of proper curvature to give surface drainage in cross section; the foundation course of stone, its thickness, and the importance of thoroughly rolling it so as to make a firm engagement upon and into the foundation clay beneath it; the application of the 2-inch stone or middle grade; and the thickness of this course, its sprinkling and rolling to a smooth, hard surface. All this was an object lesson taught by the good roads train in Raleigh, N. C., under the most unfavorable circumstances; yet it was taught, and the force of that lesson is plainly visible in many localities where before a macadam road was an unknown quantity. Aside from the local benefit derived from the good road built as a road of service, by far the greater value to the State was the educational feature, which has a scope of influence commensurate with the size of the visiting delegation, and, since that was very large, it is easy to see how the value of the visit of the good roads train to Raleigh is of incalculable benefit as an educator. Indeed, I may say truthfully that the three stops of the good roads train in North Carolina did more to arouse good roads sentiment throughout the State than any and all agencies heretofore employed combined. North Carolina will give a good account of herself at no very distant date.

*P. H. Hanes, president North Carolina Good Roads Association, Winston, N. C.:* The road built north of the city by the good roads train is an excellent piece of work, and is standing the travel beyond my expectation; in fact, it is almost a perfect piece of work. I believe the good roads movement is also growing in almost every county in this State, and within twelve months, in my judgment, its friends will be organized and ready for work. This means a great deal for North Carolina. It will cost in this section to build such roads as we are building, with granite bed in the center, 9 inches deep and 10 feet wide, with a dirt driveway 8 feet wide on either side of the macadam, about \$2,000 or \$2,500 per mile. I wish the good roads train could repeat its circuit again this fall through this section. It would do more, in my opinion, to promote the good roads movement than anything that could be done. I hope the good roads movement will continue to grow throughout the entire country.

*Earle Sloan, State geologist, Charleston, S. C.:* With relation to the short bit of road constructed at Charleston by the good roads train, I beg to advise that careful inspection shows it to have well withstood the test to which it has been subjected. You will appreciate, however, that the traffic over this road has not been of heavy order. The interest in good roads, stimulated by your popular enterprise, is continually extending, and is worthy of the highest commendation. One of the foremost tenets proclaimed in the present gubernatorial campaign is "good roads." I most heartily approve of your work. The greatest benefits are to come to us through ready transportation from the farms to the common carrier.

#### GREAT NORTHERN RAILWAY GOOD ROADS TRAIN.

Good roads trains having been run in the South and Middle West, it was deemed advisable to comply, as far as possible, with numerous demands for object-lesson road work in the Northwest, and to that end arrangements were made with the Great Northern Railway Company to cooperate in running a good roads train over their line from St. Paul to the Northwest.

The first stop was at the Minnesota State Fair during the week beginning September 1, 1902, where was built an excellent piece of macadam road on the State fair grounds, which, however, is permanent, because the road leading from St. Paul to Minneapolis will pass through these grounds and over this road. The machinery was trans-

ported on 9 cars from Chicago to St. Paul over the Burlington route free of charge. The machinery companies conceded everything asked for and gave the best and most improved machinery for every variety of work necessary, and also traction engines to haul the earth-handling machinery, so for the first time animal power was dispensed with for such service.

The train left St. Paul Monday morning, September 8, at 5 o'clock, over the Great Northern road, with 9 cars of machinery, 1 dining car, and 1 sleeping car. This was the best equipped good roads train ever sent out.

The first stop on the line of the Great Northern was at St. Cloud, Minn. Here, in the midst of the granite quarries, is an unlimited quantity of what is said to be the finest granite in the world; but it lacks the cementing value which is so essential to bind the angular fragments together in order to make a properly consolidated macadam road. No macadam road had ever been built in this part of the country, and it was thought by many that this material could never be used successfully for the purpose because of the lack of cementing properties. By a slight admixture of powdered clay and gumbo, which operated as a binder, and under pressure of the heavy steam rollers there was presented a most excellent object lesson for that community and for all that section of the country. About 1 mile of road was prepared, but the macadam was placed on only about one-quarter of a mile. Two weeks after the work had been completed Mr. J. W. Abbott, special agent, made an examination of the road to ascertain whether it had been injured by the wet weather and heavy traffic, and reported the road as "preeminently satisfactory."

Fargo, N. Dak., is in the heart of the Red River country, where the land is flat and level and the soil so sticky when wet as to make the roads almost impassable. No macadam road had ever been built in this valley, and it was the common opinion prevailing there that none could be because, as claimed, the earth was too yielding to support any superstructure of stone according to the macadam method; but here success was secured in a high degree by using the same kind of granite and by pursuing the same method of consolidation as at St. Cloud. The Great Northern road transported free 200 cubic yards of granite spawls from the St. Cloud quarries. In addition to this macadam, an equal amount of gravel road was laid in Fargo, and so two object-lesson roads were left in this section.

At Grand Forks, 178 miles north of Fargo, and still in the Red River Valley, the work done at Fargo was duplicated, but on a more extensive scale.

#### WORK IN OHIO.

For the first time in its history, this Office was enabled during the past year to carry on object-lesson work in more than one place at the same time; so while the good roads train was covering the territory in the Northwest, object-lesson roads were being built in Ohio and Maryland. One of these roads is located in Leroy Township, Medina County, Ohio, and another in Dover Township, Cuyahoga County, Ohio. They are sufficiently described by a letter from Judge Steele, of Oberlin, Lorain County, Ohio, as follows:

The road now being built is something more than three-fourths of a mile in length, running due north from the center of Dover, and is intended for a model for future construction of roads in that county. The soil is hard clay, similar to that about

Oberlin; the ridges somewhat sandy, with a large quantity of boulders near by. The road, like most of our clay roads, is very good when dry, but bottomless in wet weather. Some years ago the slag from an old charcoal furnace at Dover was hauled onto the road, and for a time improved it somewhat, but, as in our own experiment on West College street with furnace slag and cinders, it disappeared in the depths.

The large amount of hard boulders in the vicinity led them to collect a large amount of this stone, and secure a crushing machine and make their own macadam material along the road. It is a question whether this stone is any cheaper than the crushed limestone we are using on the roads in this vicinity, but it is much harder than lime and not dusty from travel. The boulders are delivered at the crushers at 40 cents a ton, the money is spent in the township instead of at limestone quarries and for freight, and it enables the farmers to get pay for clearing their farms of the boulders. Nearly 300 tons have already been delivered on the ground.

The road is surveyed and grades established by the engineer. Ditches are laid out on each side to thoroughly drain the roadbed. Then the roadbed is thoroughly rolled with a 12½-ton steam roller. A layer of 6 inches of coarse sandstone is then put on, and this is thoroughly rolled.

The boulders are crushed and screened by the steam crusher, which delivers in separate bins (1) the sand and dust; (2) small stone such as will pass through a 1-inch ring; and, (3) larger stone such as will pass through a 2-inch ring. The coarser stone is spread on the prepared road to the thickness of 7 inches, which is rolled down to about a 5-inch course. Next the fine stone is put on and rolled, making the second course about 2 inches. Then sand and dust are put on and rolled down. All the stone is wet by the use of a sprinkling cart, as rolled, making a hard roadbed above the sandstone of about 7 inches in thickness. Put on in this manner it forms a stone roof almost impervious to water, smooth, and so hard that wagon travel makes very little impression.

#### WORK IN MARYLAND.

While the work was in progress in Ohio, similar work was being done on a section of the old National Pike near Cumberland, Md., which is well described in the following letter to Secretary Wilson from Mr. G. G. Townsend, civil engineer, Frostburg, Md., dated December 22, 1902:

Thinking that you will be interested in knowing of the good effects of the road work done in this county (Allegany) by Hon. Martin Dodge, last summer, I take pleasure in stating: (1) That under the supervision of Mr. Charles T. Harrison, road expert of your Department, one of the worst hills on the turnpike between Frostburg and Cumberland, where the old roadbed was worn out and washed away, was practically remade and brought to a firm shape, and surfaced with broken limestone and screenings for a distance of about three-fourths of a mile. The work was most thoroughly done and reflects great credit upon the men in charge, and could have been completed to a much greater length for the appropriation except for the exorbitant cost of material furnished from the county quarry, where Mr. Harrison was obliged to get his stone and screenings. The road is directly on the trolley road between Frostburg and Cumberland, and is seen by almost everybody using the road; (2) that the building of the road induced the county commissioners to add screens and loading bins to their formerly very incomplete crushing plant at the quarry, and taught them and the road supervisors that road material, to attain good results, has to be laid onto a properly shaped and rolled subgrade in layers, the size of the stones in each layer decreasing toward the top and ending with screenings. Up to this time no screens had been used, and the product of the quarry had been dumped indiscriminately into the railroad cars, with the result that by the time the stone got onto the road the finest had all sifted to the bottom and the coarse stones lay on top, and it required months or years of travel to roll them smooth, quantities of the stone in the meantime being kicked into the ditches and lost; (3) that the commissioners have also, from the sample road, seen the advantages to be derived from the use of the steam roller, and have bought the one that was used by Mr. Harrison, and used it since in continuing the good work inaugurated by him. All of these things had been repeatedly brought to the attention of the commissioners before by road books and newspaper articles, but nothing seemed to reach their case until the object lesson came and compelled them to learn. There is nothing equal to the kindergarten for young or old.

I think if the appropriations could be increased for this work so that wide-tire tests could be carried on in connection with the sample-road work, the two would



do much more good than either one separately. Teach men how to *make* a road and *keep* it good. I predict a bright future for the Office of Public Road Inquiries and its work of education, and hope that its resources may be made equal to its needs.

## WORK IN ARKANSAS.

As a result of the State good roads convention held at Little Rock, Ark., January 22 to 23, 1903, the good roads movement has received a great impetus in that State. A number of local conventions have been held in Arkansas since that time and several requests have come to this Office for cooperation in object-lesson road building. Road Expert Charles T. Harrison was therefore sent, in response to one of these invitations, to Fort Smith, where he was engaged in giving instruction in work during the months of March and April. A description of the work done at Fort Smith is contained in the following letter just received from Hon. William A. Falconer, county judge, Fort Smith, Ark.:

That portion of the Van Buren road built by you was surfaced with about 2 inches of Joplin gravel, i. e., screenings from the zinc mines, placed, as you know, on top of the sandstone screenings. The foundation is very firm, but the surface wears some, and the Joplin gravel gets very dusty after a few days of hot, dry weather. This portion of the road, because of the very unfavorable conditions at the quarry, and because this was the initial trial, cost at the rate of \$5,000 per mile, and perhaps more. We finished up to the first railway track, 1,700 feet, with the crushed stone and screenings, but surfaced it from the point where you stopped to the track with the chert from Gravette, Ark., on the Kansas City Southern Railway, which road generously gave us the freight on 10 carloads of this material. I can say, unhesitatingly, that this is the finest surfacing I have ever seen, and I believe that it can not be excelled. It binds together readily and makes a smooth, hard surface that sheds the water and is free from dust. We put it on about 4 inches thick. I had fears that the chert might prove soft, and I looked to the gravel to give it hardness. From the first railroad crossing to the point now fully completed we prepared the roadbed as you had directed, but departed from your teaching in putting in the foundation. The quarry and crusher were proving so expensive that I had to abandon them or abandon the road. We had the stones hauled, just as they came from the quarry, and broken on the road with hammers, then rolled to a depth of about 8 inches. Over that we placed the chert. After several months of hard usage, of much wet weather as well as dry, the road so finished has gotten better rather than worse. There is not a rut in it, and it seems almost perfect. It convinces me that with the chert as a covering to cement and hold the rocks in place, crushing and screening are not necessary. We now have  $1\frac{3}{4}$  miles of the road laid in stone, but of this 1 mile is yet unsurfaced because of the delay in getting the chert. I have ordered 20 carloads of it, and hope to have it on before long. I expect to build 2 miles, and perhaps  $2\frac{1}{2}$  or more, on this road this year. The total cost of the road, built in the manner indicated, stone broken on the road, surfaced with chert, which is also broken on the road and rolled, will not exceed \$2,500 per mile, and may perhaps be as low as \$2,300.

I have had the crusher moved from the Van Buren road out to the Greenwood road, between that road and the Texas road, and have made an arrangement with Mr. Harrington, who owns the quarry, whereby he is to take the plant, crush the stone, furnish it, pay all expenses, and deliver it on the road at \$1.15 per yard. This will make the work on the Greenwood road much more economical than that on the Van Buren road.

You will be glad to know that this Fort Smith district of Sebastian County is in fine financial shape; its scrip is at par, and we had a surplus on settlement of \$18,000. I can promise a nice sum to work with in case the Government will do for us what it has long promised. We want you back to put in a good stretch on the Texas road.

Judge Little, our Congressman, and Mr. Reid, another Congressman, took great interest in the road movement, and would appreciate some more object-lesson work here. Our weather will permit of work until Christmas and perhaps later. We have everything in readiness—the crusher placed and the stone ready. Let me hear from you soon, so that we may know what to expect.

## WORK IN WEST VIRGINIA.

In October, 1902, work on an object-lesson road near Morgantown, W. Va., was begun under the direction of Road Expert Charles T. Harrison. Considerable grading was done in the fall, but owing to the lateness of the season the work had to be postponed until this spring. The reshaping of the subgrade was begun as early as the weather would permit, and about the middle of June the macadam work was commenced. The soil over which this road is being built is a sticky red clay, and the rainy weather of the present season has greatly retarded the work. In spite of the heavy grading to be done and the adverse climatic and soil conditions, over a half mile of first-class macadam road has now been completed. On the 10th and 11th of July the first West Virginia good roads convention was held at Morgantown. Delegates were present from all parts of the State, and it is very gratifying to learn that an unusual interest has been aroused in all parts of the State as a result of this convention and the object-lesson road work done at Morgantown. It is expected that the county of Monongalia, in which the work is being done, will soon issue bonds for the improvement of the leading highways. It is also learned from good authority that the recommendations of the Morgantown convention providing for the substitution of the money tax for the statute labor system now in vogue will be carried out by the next session of the legislature.

## WORK IN TENNESSEE.

Object-lesson road work has been in progress at Johnson City, Tenn., during the present season. The work is being done under the direction of Road Expert D. G. Haire. The road leads from the city to the new Federal Soldiers' Home, and more than a half mile has already been completed and declared to be the best piece of road in the State of Tennessee. The roadway is 24 feet in width, with 16 feet of macadam 8 inches in depth after consolidation, the right of way being 60 feet in width. The common earth roads in and around Johnson City, when subject to heavy traffic, become practically impassable in winter time. In fact, the road on which the object lesson is being constructed was impassable during certain portions of last winter and spring.

## PROGRESS OF THE GOOD-ROADS MOVEMENT IN THE DIFFERENT STATES.

Remarkable progress has been made throughout the country in the improvement of the public highways since this Office was established, in 1893. Previous to that time only one State, namely, New Jersey, was aiding the counties in the improvement of the public highways, but since that time the States of Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, Pennsylvania, Delaware, and California have established highway commissions, and are aiding the counties, towns, and townships by money donations out of the State treasury. In New Jersey the State contributes one-third of the cost, in New York one-half of the cost, in Connecticut two-thirds and in some cases three-fourths of the cost, while the counties, towns, townships, and property owners contribute the balance. Other States—namely, Maryland, North Carolina, Michigan, and Illinois—have established highway commissions for the purpose of collecting

and disseminating information, but as yet these States have made no appropriation to aid in the actual construction of the roads.

Since January 1, 1903, there have been introduced in the legislatures of 30 States over 70 bills, of general character, looking to the improvement of the roads in those States, besides a considerable number of bills to enable individual counties to take up road work by issuing bonds or levying special taxes. The majority of these bills failed to become laws; but the fact that they were introduced leads to the belief that the time is not far distant when steps to improve all the important roads throughout the United States will be taken.

The following is a brief review of some of the most important work recently done in different States:

ALABAMA.—The recent legislature passed a general law permitting counties to vote at any time for a bond issue or a special tax levy for roads.

CALIFORNIA.—The last legislature of California appropriated \$25,000 with which to continue the work on State roads.

CONNECTICUT.—In the State of Connecticut the legislature has appropriated for the building of State roads from 1895 to 1902 the sum of \$1,233,000, and during the same period the counties have appropriated for State road work \$810,942.55. In the building of State roads the State pays two-thirds of the cost in towns having a taxable valuation of over \$1,000,000 and three-fourths in towns having a taxable valuation of less than \$1,000,000, and the towns pay the balance of the cost. The towns are required to repair State roads, but if they fail to do so the State repairs them and charges the amount to the towns. The last legislature increased the appropriation to \$243,912.50 per year for the next two years.

DELAWARE.—The last legislature of Delaware passed a State-aid bill which provides for the appointment of three highway commissioners to have charge of the State road work, one in each county. It further provides that the expense of constructing State roads shall be borne equally by the State and the county interested, and \$30,000 per year for the next two years was appropriated as the State's share of the expense for road improvement.

FLORIDA.—A recent act of the legislature sets aside for the improvement of roads the Indian war claims, the payment of which has been authorized by Congress. From this the State will realize over a half million dollars. Another act recently adopted provides that all moneys now in the internal improvement fund, or which may be derived from the sale of State swamp or overflowed lands shall be devoted to the construction of hard roads, being divided among the several counties in proportion to their assessed valuation.

ILLINOIS.—The legislature of Illinois recently enacted a law providing for the appointment of a good-roads commission consisting of three persons. They are to investigate road problems of the State, and are directed to report a bill to the next legislature embodying the principles of National, State, and county cooperation in the improvement of the highways. A bill was also passed providing for the use of convicts in the preparation of road material in quarries located on the



grounds of penal institutions, the material to be donated to the counties free of cost.

MAINE.—Amendments to the State-aid law of 1901 were adopted by the last legislature providing that the amounts payable to the towns for permanent improvements to main roads are to be increased from \$100 to \$200 per year and for annual appropriation by the State for this purpose of \$20,000 instead of \$15,000 heretofore appropriated.

MARYLAND.—The highway commission of Maryland was established by the general assembly in 1896, for the purpose of investigating the conditions of the roads in the State and the best methods of improving the same. Since 1896 \$10,000 has been appropriated every two years for carrying on the work of this commission.

MASSACHUSETTS.—From 1894 to 1903 the legislature of Massachusetts has appropriated \$6,750,000 for the building of State roads. During this time 480 miles of road have been built by the State and practically 600 miles by the towns or cities. The recent legislature appropriated \$2,250,000 to be expended for the State highways during the next five years.

MICHIGAN.—The last legislature passed an act providing for the appointment of a State highway commissioner, to whom all local road officials throughout the State are to make annual reports. The commissioner is to study road conditions and furnish information to the counties.

NEBRASKA.—The legislature of Nebraska recently passed a bill providing for cooperation with the Federal Government whenever National road construction shall be undertaken.

NEW HAMPSHIRE.—The legislature of New Hampshire passed a bill providing for the appointment of a State engineer, who shall prepare a highway map of the State and plan a system of continuous main highways which shall include every town in the State; \$10,000 was appropriated for this purpose. It is also provided in the bill that the governor and council shall prepare a bill for the next general assembly which will provide fully for the inauguration of a system of State work and of State expenditure in the future construction and repair of highways.

NEW JERSEY.—The State-aid law of New Jersey was adopted in 1891 and became operative in 1892. It provides that one-third of the expense of building State roads shall be borne by the State, and that the balance shall be paid by the county in which the road is located, and that such roads are to be built under the direction and according to the specifications of the State commissioner of public roads. The State's expenditure for any one year is limited to \$400,000, while the counties are limited to one-fourth of 1 per cent of their assessed valuation. Under this law 800 miles of road have been built from 1893 to 1902, the total amount expended by the State for this purpose being \$1,265,168.55.

NEW YORK.—The State-aid law of New York, approved March 24, 1898, provides that the State shall pay 50 per cent, the counties 35 per cent, and the towns or property owners 15 per cent of the cost of

improved roads. Up to the present time 242 miles of road have been built under this law, 242 miles are now in process of construction, and petitions are on file in the office of the State engineer for 2,300 miles, for which the counties and towns have already appropriated their half of the cost. The State has already appropriated under this act \$2,065,000. The counties and towns have spent an equal sum. The last session of the legislature adopted a constitutional amendment which provides that the State may bond itself for \$5,000,000 a year for ten years for the purpose of building wagon roads. This amendment must be passed by the next legislature and then submitted to the popular vote before it becomes effective.

**NORTH CAROLINA.**—North Carolina has a highway commission, established two years ago. The commission is composed of the State commissioner of agriculture, State geologist, and the State secretary of agriculture. Its duty is to collect and disseminate information and to report to the legislature.

**PENNSYLVANIA.**—A State-aid bill was recently adopted by the legislature of Pennsylvania, which provides that two-thirds of the cost of building the roads is to be paid by the State, one-sixth by the county, and one-sixth by the township. A highway commission was established, and \$6,500,000 appropriated to be apportioned among the different counties in proportion to mileage of road in each county, and to be expended during the next six years. One-half of the expense of making repairs to State roads is to be paid by the State and the balance by the counties and townships.

**RHODE ISLAND.**—The last legislature passed a resolution appropriating \$100,000 for the construction and maintenance of highways under the direction of the State board of public roads, which was created by the preceding legislature.

**SOUTH CAROLINA.**—In South Carolina an act was passed authorizing the county commissioners of any county to hold elections to decide upon bonding the county for the permanent improvement of the highways to an amount not to exceed \$200,000, or 8 per cent of the assessed valuation of the county, the fund so raised to be expended under the direction of said commissioners. Another act was passed permitting counties to work convicts with ten-year sentences in chain gang. Hitherto the counties have not been permitted to work convicts whose terms of sentence exceeded five years.

**VERMONT.**—The State-aid law of Vermont became effective in 1898. It provides for the appointment of a State highway commissioner, who has supervision, through the town commissioners, of the expenditure of all moneys appropriated by the State for highway improvements. The law also provides for a State tax for highway improvement, which is redistributed to the towns on the basis of mileage. The towns are required to use their apportionment of State aid in permanent road work, and to expend a sum equal to their apportionment to the satisfaction of the State highway commissioner before they receive any State aid. The 5 per cent State tax provided for by law raised during the year 1901 the sum of \$88,621 and during the year 1902 \$89,057. This money was apportioned to the counties by the highway commissioner in proportion to mileage.

**PLANS FOR 1903-1904.**

During the ensuing year it is intended to continue the work already begun and enlarge its scope so far as the appropriation will permit. The work in Ohio, West Virginia, and Tennessee will be completed during the present season, and object-lesson and experimental work will be done at the Natural Bridge of Virginia and also at Tomah, Wis. Urgent applications for similar help have been on file from a large number of places in the Middle West for two or three years, and it is proposed to comply with one or two of these requests during the present season and to take up similar work in two or three other places next spring.

Other applications for assistance, advice, and cooperation in road conventions and road work will be accepted during the winter and spring, as the occasion demands and our force will permit.

**RECOMMENDATIONS AND ESTIMATES FOR 1904-1905.**

The reports of Government cooperation in object-lesson road building quoted in this report seem to prove not only the statement made at the outset, that a good road makes converts to permanent highway improvement, but also that a good road built under the direction of the United States Government in any community has the effect of awakening much greater interest than such a road constructed by the local authorities. Many communities showing advances in almost every line of progress are making no effort at all to improve their highways, nor will they do anything until Government representatives and Government machinery give them an impetus in this direction. This Office has over 100 applications on file for object-lesson road work in different parts of the country, and every mail brings inquiries along that line. It would be a great help to the whole country if it were possible to comply with even a majority of these requests, for then the different communities would go on with the work.

In the object-lesson and experimental road work of the Office we endeavor to study all local conditions, such as climate, soil, rainfall, drainage, and materials adjacent to the roads. We also locate and test all available materials, and show by practical object lessons how to use them to the best advantage in order to build good roads with the least expenditure of money and labor. It is also necessary to demonstrate the use and value of the modern road-building machines, such as the crusher, elevator, screens, and bins, the spreading carts to carry the material from the bins to the road without rehandling, and the steam roller to consolidate the materials. Heretofore the Department has depended upon the road-machine companies to supply these machines for object-lesson and experimental road work. During the present season, however, this Office has had considerable difficulty in securing sufficient machinery; the manufacturers have not been able to fill their regular orders, and have therefore been unwilling to fully supply the Department. I would therefore recommend that at least \$10,000 be added to our next year's appropriation for the purchase of machinery and apparatus for use in experimental and object-lesson road work.

In view of the fact that funds from the appropriation for the Office are expended only for supervision and not for construction, we have been able to accomplish a maximum of good results, and it is believed



that for every dollar expended by the Government the local and State authorities have been stimulated to expend at least \$10 in object-lesson and experimental road work.

I would therefore urgently recommend that the appropriation for this Office for the fiscal year 1904-1905 be increased from \$35,000 to \$75,000.

The work of this Office appears to be no longer of tentative character. Year after year it has assumed increased importance and wider scope, and there is now a general demand coming up from all sections of the country that it be made a permanent feature of the work of this Department. It appears fitting, therefore, that it be given a more definite legal status, thereby adding dignity and stability to this branch of the Department's work. I therefore respectfully recommend that the Office of Public Road Inquiries be transformed into the Division of Public Roads, with a statutory roll of officers and employees.



## REPORT OF THE CHIEF OF THE DIVISION OF ACCOUNTS AND DISBURSEMENTS.

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U. S. DEPARTMENT OF AGRICULTURE,  
DIVISION OF ACCOUNTS AND DISBURSEMENTS,  
*Washington, D. C., August 27, 1903.*

SIR: I have the honor to submit herewith a report of the work of the Division of Accounts and Disbursements for the fiscal year ended June 30, 1903.

F. L. EVANS, *Chief.*

Hon. JAMES WILSON, *Secretary.*

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### WORK OF THE YEAR.

#### APPROPRIATIONS, EXPENDITURES, ETC.

The appropriations for the year ended June 30, 1903, including \$510,000 for deficiencies, amounted to \$5,013,960, an increase over the appropriations of the preceding year of \$1,091,231.54. Of this sum, \$4,296,882.60 were disbursed during the year, leaving a balance of \$717,077.40, the greater part of which sum is covered by outstanding liabilities.

In addition to the above, \$720,000 was appropriated for the forty-eight agricultural experiment stations in the several States.

The supplemental accounts for the years 1901 and 1902, paid during the year, amounted to \$353,329.41.

The unexpended balances of the appropriations for the year 1901, amounting to \$65,127.50, were finally covered into the Treasury on June 30, 1903.

There were received, audited, and paid 29,534 accounts, as follows: Weather Bureau, 10,465, amounting to \$1,122,653.31; Bureau of Animal Industry, 5,686, amounting to \$1,302,573.69; Bureau of Plant Industry, 4,388, amounting to \$502,249.78; Bureau of Soils, 1,532, amounting to \$116,590.09; Bureau of Forestry, 2,462, amounting to \$190,858.30; Bureau of Chemistry, 901, amounting to \$55,566.37; divisional, 4,099, amounting to \$1,006,393.06—a total of \$4,296,882.60. In payment of these accounts 40,584 checks were drawn on the Treasury at Washington and subtreasuries at New York and Chicago; of these seven were lost, two in transit through the mails and five by the persons in whose favor they were issued.

#### REQUISITIONS, LETTERS, REQUESTS, CONTRACTS, AND LEASES.

To cover all expenditures against the various appropriations of the Department 146 requisitions were drawn on the Treasury, aggregating \$4,427,110.04.



The number of requisitions issued for supplies was 13,634.

The number of letters of authorization for travel was 2,406.

The number of letters written and received in the ordinary transaction of business was 49,254.

The number of requests issued for passenger transportation was 4,845.

The number of requests on the Quartermaster-General for transportation of Government property was 2,575.

The number of leases and agreements executed and in effect was 168.

The number of contracts for supplies, etc., was 446.

The amount expended for telegraphing and telephoning by the Weather Bureau, including the West Indian cable service, was \$197,258.87.

#### MONTHLY CHECK STATEMENTS, SETTLEMENT OF ACCOUNTS, ETC.

The check statements presented monthly by the Treasury and sub-treasuries were, upon comparison, found to agree with the books of this office. The annual report to Congress of all expenditures of the Department for the year 1902 was prepared in this office and submitted through the Speaker of the House of Representatives, in conformity to a law which relates only to this Department.

#### PUBLIC MONEYS RECEIVED FROM VARIOUS SOURCES.

There were received from all sources and deposited in the Treasury, to the credit of the proper funds, the following sums:

Sales of condemned property.....	\$3, 923. 59
Sales of card index .....	157. 05
Sales of publications, Weather Bureau .....	295. 30
Seacoast telegraph line receipts, Weather Bureau .....	2, 687. 58
Sales of American products in Europe .....	4, 026. 69
Sales of products, agricultural experiment station, Hawaii .....	382. 75
Sales of products, agricultural experiment station, Porto Rico .....	782. 45
Sales of experimental shipments of fruits to Europe .....	548. 15
Total .....	12, 803. 56

#### APPROPRIATIONS, DISBURSEMENTS, AND UNEXPENDED BALANCES.

The following table shows the appropriations, disbursements, and unexpended balances for the year ended June 30, 1903:

*Appropriations, disbursements, and amount unexpended for the fiscal year 1903.*

Object.	Amount appropriated.	Amount disbursed.	Amount unexpended.
Salaries, officers and clerks .....	\$465, 500	\$449, 599. 88	\$15, 900. 12
Library .....	8, 000	6, 427. 38	1, 572. 62
Contingent expenses .....	43, 000	38, 241. 42	4, 758. 58
Bureau of Plant Industry:			
Vegetable pathological investigations .....	110, 000	97, 490. 20	12, 509. 80
Pomological investigations .....	30, 000	28, 192. 12	1, 807. 88
Botanical investigations and experiments .....	55, 000	50, 784. 88	4, 215. 12
Grass and forage plant investigations .....	30, 000	24, 776. 40	5, 223. 60
Experimental gardens and grounds .....	25, 000	24, 740. 69	259. 31
Arlington experimental farm .....	15, 000	14, 819. 93	180. 07
Investigating production of domestic sugar .....	5, 000	3, 677. 12	1, 322. 88
Tea-culture investigations .....	10, 000	4, 634. 74	5, 365. 26
Purchase and distribution of valuable seeds .....	270, 000	253, 133. 70	16, 866. 30

*Appropriations, disbursements, and amount unexpended for the fiscal year 1903—Cont'd.*

Object.	Amount appropriated.	Amount disbursed.	Amount unexpended.
Bureau of Forestry .....	\$254,000	\$190,858.30	\$63,141.70
Bureau of Chemistry .....	60,500	55,566.37	4,933.63
Bureau of Soils .....	130,000	116,590.09	13,409.91
Entomological investigations .....	45,500	43,396.38	2,103.62
Biological investigations .....	28,000	24,269.39	3,730.61
Publications .....	204,000	174,547.88	29,452.12
Collecting agricultural statistics .....	94,200	88,833.01	5,366.99
Agricultural experiment stations (\$796,000) <sup>a</sup> .....	76,000	74,287.53	1,712.47
Nutrition investigations .....	20,000	18,372.93	1,627.07
Irrigation investigations .....	65,000	48,211.85	16,788.15
Public-road inquiries .....	30,000	28,555.45	1,444.55
Foreign-market investigations .....	6,500	5,773.25	726.75
Silk investigations .....	10,000	5,874.71	4,125.29
Bureau of Animal Industry .....	1,660,000	1,302,573.69	357,426.31
Total .....	3,750,200	3,174,229.29	575,970.71
WEATHER BUREAU.			
Salaries .....	165,260	164,927.46	332.54
Fuel, lights, and repairs .....	10,000	9,489.07	510.93
Contingent expenses .....	8,000	6,639.79	1,360.21
General expenses, salaries .....	915,500	796,239.32	119,260.68
Meteorological observation stations .....	60,000	54,808.15	5,191.85
Buildings .....	50,000	35,645.47	14,354.53
Cables and land lines .....	40,000	40,000.00	—
Storm-warning stations, Glenhaven and South Manitou Island, Mich. ....	15,000	14,904.05	95.95
Total, Weather Bureau .....	1,263,760	1,122,653.31	141,106.69
Grand total .....	5,013,960	4,296,882.60	717,077.40

<sup>a</sup>Of this amount, \$720,000 was paid directly to the experiment stations from the Treasury Department.

#### ACCOUNTS FOR THE FISCAL YEAR 1901 FINALLY CLOSED.

The accounts for the year ended June 30, 1901, were finally closed on June 30, 1903, and the balances under the various appropriations were returned to the Treasury on that date and carried to the surplus fund, as follows:

*Amount of unexpended balances turned into the Treasury.*

Object.	Amount appropriated for 1901.	Amount disbursed.	Amount unexpended.
Salaries, officers and clerks .....	\$326,680.00	\$319,809.25	\$6,870.75
Library .....	5,000.00	4,118.93	881.07
Contingent expenses .....	37,000.00	35,623.95	1,376.05
Animal quarantine stations .....	50,000.00	49,343.52	656.48
Collecting agricultural statistics .....	110,000.00	109,729.76	270.24
Botanical investigations and experiments .....	30,000.00	29,590.49	409.51
Entomological investigations .....	22,500.00	22,265.57	234.43
Vegetable pathological investigations .....	28,000.00	27,488.57	511.43
Biological investigations .....	17,500.00	17,195.83	304.17
Pomological investigations .....	9,500.00	9,315.11	184.89
Laboratory .....	28,500.00	28,395.45	104.55
Forestry investigations .....	80,000.00	79,695.87	304.13
Experimental gardens and grounds .....	20,000.00	19,986.72	13.28
Soil investigations .....	25,000.00	24,924.94	75.06
Grass and forage plant investigations .....	17,000.00	15,225.83	1,774.17
Irrigation investigations .....	50,000.00	49,973.09	26.91
Agricultural experiment stations (\$780,000) <sup>a</sup> .....	<sup>b</sup> 60,251.01	59,883.47	367.54
Nutrition investigations .....	17,500.00	17,499.67	.33
Arlington experimental farm .....	10,000.00	9,946.03	53.97
Public-road inquiries .....	14,000.00	13,990.76	9.24
Publications .....	105,000.00	104,680.67	319.33
Purchase and distribution of valuable seeds .....	170,000.00	149,615.49	20,384.51

<sup>a</sup>Of this amount, \$720,000 was paid directly to the experiment stations from the Treasury Department.

<sup>b</sup>Including \$251.01 received from sales of card index.

*Amount of unexpended balances turned into the Treasury—Continued.*

Object.	Amount appropriated for 1901.	Amount disbursed.	Amount unexpended.
Investigating production of domestic sugar.....	\$7,000.00	\$6,690.25	\$309.75
Tea-culture investigations .....	5,000.00	4,959.42	40.58
Salaries and expenses, Bureau of Animal Industry .....	21,000,514.96	976,566.75	23,948.21
Total .....	2,245,945.97	2,186,515.39	59,430.58
WEATHER BUREAU.			
Salaries.....	153,320.00	152,688.11	631.89
Fuel, lights, and repairs.....	9,000.00	8,877.36	122.64
Contingent expenses .....	8,000.00	7,906.40	93.60
General expenses.....	828,000.00	824,130.64	3,869.36
Meteorological observation stations.....	60,000.00	59,019.49	980.51
Total, Weather Bureau.....	1,058,320.00	1,052,622.00	5,698.00
Grand total.....	3,304,265.97	3,239,137.39	65,128.58

<sup>a</sup> Including \$514.96 received from sales of American butter in foreign markets.

## ANNUAL SUPPLIES.

Schedules designed to include in carefully estimated quantities the various classes of supplies for the use of the Department during the last year were furnished to all persons applying therefor, at the usual time and under prescribed conditions. All bids received were carefully considered by the board of awards, acting in compliance with the provisions contained in the act approved January 27, 1894, and contracts were made at the most advantageous prices obtainable for the grade of supplies needed. Bonds were required from all contractors where the amount involved in the contract justified a strict enforcement of the rule in this regard. All supplies not included in the annual schedules and called for by the several branches of the Department after the annual contracts had been made, where the amount exceeded \$50, were obtained on informal bids, which bids were duly passed on by a board of awards, and contracts made with the lowest responsible bidder, all accepted bids receiving the approval of the Secretary. In the case of supplies, the amount being less than \$50, bids were secured on forms designed for the purpose. It is the unvarying custom of this Department to secure competition on all supplies, the only exception being where the supplies needed are patented and obtainable only from a single source. In such cases an exigency statement is required by this office from the chief of Bureau, Office, or Division, requesting the supplies, fully and clearly setting forth this fact, and explaining the necessity for requiring the particular kind and grade of goods requested, also showing that the price named in requisition is the lowest obtainable, as established by correspondence or other satisfactory evidence.

## CONTRACT WITH THE CHESAPEAKE AND POTOMAC TELEPHONE COMPANY.

A contract for telephone service, which had been in effect for several years between the Department of Agriculture and the Chesapeake and Potomac Telephone Company, expired June 30, 1902. About thirty days before that date the Department called on the Chesapeake and Potomac Telephone Company to execute a new contract; this the tele-



phone company declined to do on terms satisfactory to the Department. Upon the failure of negotiations to secure a new contract the Secretary of Agriculture directed the chief of the Division of Accounts and Disbursements to go fully and carefully into the subject of telephones in the Department, and to ascertain the feasibility and advisability of substituting a private interior telephone system as far as practicable for the public system then in use. As a result of this inquiry, 22 of the 42 Chesapeake and Potomac Telephone Company's telephones were ordered to be removed, and a private interior system was installed. This new system, which went into operation on December 6, 1902, was secured after liberal competition had been invited and the merits of the several telephone systems in successful operation had been fully compared, and after consultation with Government electricians as to certain technical features. It is a central-energy system, fully equipped with instruments, power board, and the latest improved switchboard. The telephones are of the best type, and all ringers, cords, plugs, jacks, switches, and other equipment are first-class in every particular. The switchboard, made of solid mahogany, is provided with automatic lamp-lighting signals and the latest and best listening and ringing devices. The ultimate capacity of the switchboard is 100 telephones. The number of telephones now in use is 44, with requests from several of the Bureaus aggregating 15 additional.

The whole expense for repairs from date of installation until now has been \$1.50. The cost of power for running the system is 7½ cents per day. The entire cost of the system, including switchboard and 60 telephones, with all wiring and appurtenances, was \$2,266.52. The 44 telephones of this system answer every purpose of internal communication, and the yearly saving represented by their use, as compared with the rental of outside telephones, is practically 50 per cent of the first cost of the system. Making a liberal allowance for wear and tear, cost of power and replacement, the system pays for itself in less than three years. There has never been the slightest complaint as to the efficiency of the system. The talking qualities of the instruments are excellent, and cross circuits, burning out, and kindred troubles have been unknown. The operator who handles the switchboard for the Chesapeake and Potomac Telephone Company now handles both boards, and therefore no increased expense is incurred for an extra switchboard operator.

Two additional trunk lines were installed, connecting the Department proper with the general system of the Chesapeake and Potomac Telephone Company, central station. These additional trunk lines have greatly improved the outside telephone service, which prior to their installation was very unsatisfactory.

#### ADDITIONAL TELEPHONES IN BUREAU OF FORESTRY.

A complete Chesapeake and Potomac telephone system, unlimited service, was installed for the use of the Bureau of Forestry in the offices occupied by the Bureau in the Atlantic Building, on F street. This system includes two tie lines between the switchboard in the main building of the Department and a switchboard in the Atlantic Building, eight telephone stations and extension call, one switchboard in the Atlantic Building, and two trunk lines connecting the same

with the general system of the Chesapeake and Potomac Telephone Company. The expense of installation was charged to the Bureau of Forestry fund, and annual rental of eight telephones, \$25 each, will be borne by the same fund. Under a decision of the Comptroller of the Treasury, there will be no charge for the switchboard and the two trunk lines.

#### CONTRACTS FOR SEEDS.

Contracts were made with the firms named in the subjoined list for seeds for Congressional distribution during last year. In addition to these contracts, large quantities of seeds were bought in the open market when found to be necessary. A contract was made with the Brown Bag-Filling and Machine Company, of Fitchburg, Mass., for packeting, bagging, and distributing all seeds, for \$48,912.

*Name of contractor and estimated cost of seeds in each case, 1903.*

Name of contractor.	Estimated cost.	Name of contractor.	Estimated cost.
F. Bolgiano & Co.....	\$7,450.00	T. W. Woods & Sons:	
F. Barteldes & Co.....	162.90	Vegetable-seed contract.....	\$8,853.05
W. Atlee Burpee & Co.....	4,944.35	Tobacco-seed contract.....	694.50
E. B. Clark & Co.....	3,875.00	M. M. Miesse & Sons.....	262.00
The Goodwin Harries Co.....	11,815.00	Vaughan's seed store.....	305.94
Johnson & Stokes.....	89.60	C. C. Morse & Co.....	5,000.00
Northrup, King & Co.....	6,029.20	T. S. Williams.....	600.00
Philippus Seed and Implement Co.....	8,535.30	Mary Best.....	500.00
Jerome B. Rice Seed Co.....	19,564.25		
J. M. Thorburn & Co.....	4,715.17	Total.....	\$8,396.26

#### BUILDINGS ERECTED BY THE WEATHER BUREAU.

During the last two fiscal years buildings were erected, from specific appropriations, for use as meteorological observatories at the following-named places:

Atlantic City, N. J.:	
Cost of lot (Government reservation); cost of building.....	\$6,000.00
Hatteras, N. C.:	
Cost of lot, \$125; cost of building, \$4,875.....	5,000.00
Fort Canby (North Head), Wash.:	
Cost of lot (Government reservation); cost of building.....	3,992.63
Port Crescent, Wash.:	
Cost of lot (Government reservation); cost of building.....	1,000.00
Tatoosh Island, Wash.:	
Cost of lot (Government reservation); cost of building.....	4,950.00
Point Reyes, Cal.:	
Cost of lot (Government reservation); cost of building.....	2,989.90
Amarillo, Tex.:	
Cost of lot, \$1,255; cost of building, \$6,503.....	7,758.00
Modena, Utah:	
Cost of lot (Government reservation); cost of building.....	4,346.00
Key West, Fla.:	
Cost of lot, \$2,020; cost of building, \$7,994.75.....	10,014.75
Sand Key, Fla.:	
Cost of lot (Government reservation); cost of building.....	5,593.00
Southeast Farallone, Cal.:	
Cost of lot (Government reservation); cost of building.....	5,211.22
Mount Weather, Va.:	
Cost of lot, \$1,413.90; cost of observatory building and stable, \$15,663.13.....	17,077.03
Total cost of buildings, including additional work.....	73,932.53
Total number of buildings so far erected, 12.	

In addition, it has been possible to repair and improve the following buildings, at the total cost set opposite each, viz:

Bismarck, N. Dak.....	\$7,064.14
Jupiter, Fla.....	3,358.00
Kittyhawk, N. C.....	125.00
Cape Henry, Va.....	5,104.25

Total cost of these repairs and improvements..... 15,651.39

Total number of buildings repaired and improved, 4.

*Buildings now in course of erection by the Weather Bureau, and approximate cost of each.*

Yellowstone Park, Wyo.:

Cost of lot (Government reservation); cost of building..... \$11,500.00

Duluth, Minn.:

Cost of lot, \$2,100; cost of building, \$7,900..... 10,000.00

Devils Lake, N. Dak.:

Cost of lot, \$2,300; cost of building, \$8,000..... 10,300.00

Havre, Mont.:

Cost of lot, \$1,850; cost of buildings, \$5,700..... 7,550.00

Mount Weather, Va.:

Cost of lot, \$650; cost of power house and balloon building, \$10,000. 10,650.00

Block Island, R. I.:

Cost of lot, \$1,100; cost of building, \$7,700..... 8,800.00

#### APPROPRIATIONS FOR WEATHER BUREAU BUILDINGS, CABLES, ETC.

The sum of \$50,000 is appropriated for 1904 for the purchase of sites and the erection of not less than five buildings for use as Weather Bureau observatories; \$40,000 is appropriated for same year for the purchase and construction of a cable and land lines between Block Island and Narragansett Pier, R. I., including the purchase of sites and the erection of buildings at the terminal places.

#### BUILDINGS ERECTED BY THE BUREAU OF ANIMAL INDUSTRY.

One dwelling and 7 barns were erected at the Athenia, N. J., quarantine station of the Bureau of Animal Industry, at a total cost of \$43,949, as follows:

Dwelling.....	\$2,884	Barn C 2.....	\$4,019
Barn A 1.....	3,265	Barn C 4.....	5,193
Barn B 1.....	4,139	Barn C 5.....	11,437
Barn C 1.....	4,019	Barn E 4.....	8,993

These buildings were erected under contract, after liberal advertising, by the David Henry Building Company and the P. S. Van Kirk Company, of Paterson, N. J.

#### BETHESDA EXPERIMENT STATION.

Thirty acres of land adjoining the Bureau of Animal Industry experiment station at Bethesda, Md., were purchased from Elizabeth J. Wilson et al., at an aggregate cost of \$10,000.

#### SEED WAREHOUSE.

The act providing for the purchase and distribution of valuable seeds, 1903, permits the "erection of a suitable seed warehouse on the Department grounds, at a cost not to exceed \$10,000." In com-



pliance with this provision a contract was made, after advertising, August 6, 1902, with W. H. McCrag, of Washington City, for \$8,550. Some additional expenses were incurred in arranging and fitting up this building.

#### ADMINISTRATIVE BUILDING.

The act making appropriations for sundry civil expenses of the Government for the fiscal year ending June 30, 1904, contained the following:

To commence the erection of a new building for the Department of Agriculture, authorized by the act approved February ninth, nineteen hundred and three, two hundred and fifty thousand dollars, of which sum one hundred thousand dollars shall be immediately available; and the Secretary of Agriculture is hereby authorized to enter into a contract or contracts for the completion of said building within the limit of cost of one million five hundred thousand dollars fixed by said act.

No payments have been made on account of the money thus appropriated, except for services provided for as follows:

That the supervision of the construction of said building shall be placed in charge of an officer of the Government especially qualified for the duty, to be appointed by the Secretary of Agriculture, subject to the approval of the head of the Department in which such officer is employed, who shall receive for his additional services an increase of twenty-five per centum of his present salary, such increase to be paid out of the appropriation for the building herein authorized.

#### NEW BOILERS IN GREENHOUSES.

Three new 40-horsepower horizontal return tubular boilers, containing forty-six 3-inch tubes, were installed in the Department greenhouses at a cost of \$1,890.

#### DEFICIENCY APPROPRIATIONS.

Appropriations to supply deficiencies were made as follows:

FISCAL YEAR 1903.—Bureau of Animal Industry, \$500,000, to enable the Secretary of Agriculture to stamp out and eradicate foot-and-mouth disease and other contagious diseases of animals; contingent expenses, \$6,000, to meet the extraordinary advance in the price of coal during the coal strike last winter, which made it necessary to go outside of the regular contracts; also to provide for the installation in the Department and annexes of a complete interior telephone system; publications, \$4,000, for labor and material required in distribution of documents.

FISCAL YEAR 1902.—Entomological investigations, \$3,013.18, to adjust and pay the claim of W. C. Heath, of Victoria, Tex., arising under a contract dated March 8, 1902, for growing cotton in connection with an investigation into the ravages of the cotton boll-worm, weevil, etc.

#### ESTIMATES OF APPROPRIATIONS.

The estimates of appropriations for the year ending June 30, 1904, were prepared in this office, and were submitted to Congress in the manner prescribed by law, accompanied by an explanation of all changes from the appropriations of the preceding year, with such changes italicized in the estimates, for the guidance of the Congress-

sional committees. These estimates amounted to \$4,940,150, or \$436,190 more than the appropriations for 1903, exclusive of urgent deficiencies to 1903 of \$510,000. With the exception of the Weather Bureau, all branches of the Department estimated for increased appropriations for 1904.

#### APPROPRIATIONS AND ESTIMATES FOR 1904.

The appropriations and estimates for 1904 are shown in the following table:

#### *Appropriations and estimates for 1904.*

Object.	Amount appropriated for 1904.	Amount estimated for 1904.
Salaries, officers and clerks.....	\$471,080	\$483,550
Bureau of Animal Industry, general expenses, emergency appropriation of \$500,000 .....	1,700,000	1,250,000
Bureau of Plant Industry:		
Vegetable pathological investigations .....	130,000	135,000
Pomological investigations.....	37,000	40,000
Botanical investigations and experiments .....	65,000	65,000
Grass and forage plant investigations .....	35,000	40,000
Experimental gardens and grounds.....	25,000	30,000
Arlington experimental farm .....	15,000	25,000
Tea-culture investigations.....	10,000	15,000
Purchase and distribution of valuable seeds .....	290,000	280,000
Investigating production of domestic sugar .....	5,000	5,000
Bureau of Forestry.....	312,860	337,140
Bureau of Chemistry.....	70,500	80,500
Bureau of Soils.....	170,000	195,000
Entomological investigations .....	65,500	75,500
Biological investigations, including \$1,000 for care of game.....	34,000	38,000
Publications.....	260,000	210,000
Collecting agricultural statistics .....	109,200	109,200
Foreign-market investigations .....	7,500	9,000
Library.....	10,000	10,000
Contingent expenses .....	37,000	37,000
Agricultural experiment stations (\$810,000) <sup>a</sup> .....	90,000	91,000
Nutrition investigations.....	20,000	22,500
Irrigation investigations.....	65,000	75,000
Public-road inquiries.....	35,000	33,000
Total .....	4,009,640	3,691,390
WEATHER BUREAU.		
Salaries .....	175,440	165,780
Fuel, lights, and repairs.....	6,000	10,000
Contingent expenses .....	8,000	8,000
General expenses, salaries.....	969,080	915,500
General expenses, miscellaneous.....		
Meteorological observation stations .....		60,000
Buildings.....	50,000	50,000
Cables and land lines.....	40,000	39,480
Total, Weather Bureau .....	1,248,520	1,248,760
Grand total .....	5,258,160	4,940,150

<sup>a</sup> Of this amount, \$720,000 is paid directly to the experiment stations from the Treasury Department.

#### IMMEDIATELY AVAILABLE APPROPRIATIONS.

The appropriations for 1904 contain the following immediately available provisions:

Vegetable pathological investigations .....	\$5,000
Laboratory .....	10,000
Entomological investigations .....	12,000
Collecting agricultural statistics .....	5,000
Public-road inquiries .....	3,000

Against these funds liabilities were incurred prior to July 1, 1903, amounting to \$12,644.17, as follows:

Vegetable pathological investigations .....	\$1, 475. 00
Laboratory .....	Nothing.
Entomological investigations .....	8, 425. 75
Collecting agricultural statistics .....	846. 00
Public-road inquiries .....	1, 897. 42

Immediately available appropriations add greatly to the bookkeeping both in this Department and at the Treasury Department. The practice of asking for immediately available appropriations is only of recent origin, and is growing into an abuse, as frequently no expense is incurred against the fund until after July 1, when the regular appropriation becomes available.

#### INCREASE IN SALARIES.

An increase in the salaries of the following officers of the Department was made by Congress, to take effect on July 1, 1903:

Chief Division of Publications .....	From..	\$2, 500 to \$3, 000
Chief Division of Accounts and Disbursements .....	do....	2, 500 to 2, 750
Chief Division of Statistics .....	do....	3, 000 to 3, 500
Private secretary to the Secretary of Agriculture .....	do....	2, 250 to 2, 500

In addition to these, the position of assistant chief of the Weather Bureau at a salary of \$3,000 was reestablished, to take effect on the same date as the above changes.

#### BUILDINGS UNDER LEASE IN THE DISTRICT OF COLUMBIA, WITH ANNUAL RENTAL.

The amount appropriated for rental for the several branches of the Department in the District of Columbia for 1904 is \$27,900, against \$21,700 for 1903, an increase of \$6,200 per year, as follows:

Bureaus and Divisions.	1903.	1904.
Bureau of Chemistry, laboratory and offices, 200 Fourteenth street SW .....	\$2, 500	\$2, 500
Bureau of Animal Industry, laboratory and offices, 1362 B street SW .....	1, 800	1, 800
Bureau of Soils, laboratory and offices, 212 and 214 Thirteenth street SW .....	2, 000	2, 000
Bureau of Forestry, offices, Atlantic Building .....	6, 000	10, 000
Bureau of Plant Industry:		
Vegetable pathology and physiology, laboratories and office, 1306 B street SW ...	3, 000	3, 000
Botanical investigation, laboratories and offices, 224 Twelfth street SW .....	3, 000	3, 000
Purchase and distribution of valuable seeds, warerooms, Thirteen-and-a-half street SW .....	2, 000	3, 000
Grass and forage plant investigations .....		1, 200
Division of Publications, document rooms, 1304 B street SW .....	1, 400	1, 400
Total .....	21, 700	27, 900

#### LAW CLERK.

Reference was made in the last annual report of the chief of this Division, also in several previous reports, to the urgent necessity for Congressional action in the matter of a law branch for this Department. The great and manifest importance of this recommendation is now urged as an excuse for again referring to the subject. It is thought that if Congress clearly understood the gravity of the situation and realized the magnitude of the work to be done annually, authority



would be granted in the appropriation act for the employment of the necessary legal assistance.

An idea of the nature and scope of the legal work now being done by the clerk detailed to this work may be had from the following brief data: During less than a year 1,625 letters were written on technical questions, 52 special; more than 200 contracts were drafted, involving several hundred thousand dollars, nearly \$50,000 being covered by one contract; leases and renewals of same, options for the purchase of land, and abstracts of title of land to be purchased were prepared; also cases for submission to the Comptroller of the Treasury; cases for the Department of Justice for prosecutions under various acts; and cases for defense in the Court of Claims, demanding great care and exhaustive research in preparation. In addition to these papers, the chiefs of Bureaus, Offices, and Divisions were advised almost daily as to the legal phases of their various operations.

These operations are indeed various. While a law clerk in the Patent Office is called upon to consider only patent cases, while a law clerk in the General Land Office deals only with matters relating to the public lands, and while the law clerks in the customs division are engaged exclusively upon questions arising under the tariff laws, the duties of the clerk assigned to the charge of the legal business of the Department of Agriculture are not confined to such narrow limits, but cover a much broader field.

From the following it will be seen that, in the matter of law officers, each of the Executive Departments of the Government, with the single exception of the Department of Agriculture, is liberally provided for, the chief official in each case being given high rank and a very respectable salary.

#### TREASURY DEPARTMENT.

Solicitor of the Treasury, an assistant solicitor, a law clerk, and a corps of clerks, etc.; Comptroller of the Treasury, an assistant comptroller, a chief law clerk, six law clerks, and numerous clerks of different classes; in the Internal-Revenue Bureau, Solicitor of Internal Revenue, with an office force, and a law division consisting of several clerks and presided over by a chief of division; in the office of the Auditor for the War Department, a law board composed of three members; in the five other auditing offices each a law clerk; in the office of the Supervising Architect, a law and record division; in the Customs Division, five law clerks; in the Appointment Division, a law and bond clerk; in the office of the Light-House Board, a title and contract clerk.

#### DEPARTMENT OF THE INTERIOR.

Assistant attorney-general, a first assistant attorney, and seventeen assistant attorneys; in the General Land Office, two clerks and two law examiners; in the Patent Office, two law clerks; in the Pension Office, a law division.

#### POST-OFFICE DEPARTMENT.

Assistant attorney-general, an assistant attorney, and a corps of clerks.

## WAR DEPARTMENT.

Judge-Advocate-General, two assistant judge-advocate-generals, one law officer, and an office force.

## NAVY DEPARTMENT.

Judge-Advocate-General, Solicitor, three navy officers detailed as assistants, and an office force.

## DEPARTMENT OF STATE.

Solicitor, an assistant solicitor, and an office force.

## DEPARTMENT OF AGRICULTURE.

In no appropriation for this Department has any provision ever been made for a law officer or law clerk.

It should be mentioned here that a certain contingency is liable to arise which will greatly increase the legal work of this Department. A bill to establish the Appalachian Park has passed the Senate, and has received careful and friendly attention from the proper committee of the House. This measure has been earnestly recommended by the Secretary of Agriculture, and, if it should be enacted into law, thousands of tracts of land must be acquired by the Government. Thousands of titles must be inquired into, and in many cases condemnation proceedings must be had. The amount of work involved in these transactions will be enormous, and will necessitate the employment of many assistants in the law branch of the Department of Agriculture.

## ASSISTANT CHIEF OF DIVISION DETAILED TO WEATHER BUREAU.

The assistant chief of this Division is detailed to the Weather Bureau, where he supervises and directs all work pertaining to the accounts division of that Bureau, the details and responsibilities of which have enormously increased during the last ten years. He is particularly charged with all work pertaining to the Weather Bureau buildings outside of the city of Washington, their erection, repair, and preservation, as well as the purchase of sites for such buildings. The Weather Bureau now owns buildings at eighteen points, of which sixteen have been constructed or extensively repaired under this officer's immediate supervision. Most of these buildings and sites are at isolated points, and the work of construction and repair is the more difficult on that account. It is but fair to record that this work has been most ably and satisfactorily conducted.

## CONDITION OF WORK IN DIVISION.

The volume of work in this Division continues to increase yearly with the growth of the Department. This increase of work is being met by the clerical assistants of the Division with the interest and efficiency characteristic of their efforts throughout. No part of the work is now in arrears.

LEASED BUILDINGS OUTSIDE OF THE DISTRICT OF COLUMBIA, WITH  
LOCATION AND MONTHLY OR ANNUAL RENTAL.

The following are the Bureau of Animal Industry, botanical, irrigation, and Weather Bureau stations under lease by the Department outside of the District of Columbia during the year ended June 30, 1903:

*Stations, with location and monthly or annual rental.*

BUREAU OF ANIMAL INDUSTRY.

Station.	Location.	Rent.
Baltimore, Md.....	215 St. Paul street.....	\$125 per month.
Boston, Mass.....	Rooms 307 and 308, third floor, 147 Milk street.....	\$75 per month.
Do.....	Rooms 309 and 310, third floor, 147 Milk street.....	\$900 per annum.
Buffalo, N. Y.....	Room in East Buffalo Live Stock Exchange Building.....	\$30 per month.
Chicago, Ill.....	Room 4, 4193 South Halstead street.....	\$225 per month.
Do.....	Suite 316, Exchange Building, Union Stock Yards.....	\$125 per month.
Do.....	2 rooms, 210 South Water street.....	\$50 per month.
Cincinnati, Ohio.....	1 room, Exchange Building, Johnson street.....	\$180 per annum.
Indianapolis, Ind.....	1 room, Live Stock Exchange Building.....	\$10 per month.
Kansas City, Kans.....	2 rooms, Live Stock Exchange Building.....	\$15 per month.
Knoxville, Tenn.....	1 room, Deaderick Building, 614 Prince street.....	\$10 per month.
Littleton, Mass.....	Quarantine station.....	
Louisville, Ky.....	1 room, 507 Johnson street.....	Do.
National Stock Yards, Illinois.....	3 rooms, Live Stock Exchange Building.....	\$30 per month.
New York, N. Y.....	2 rooms, 109 West Forty-second street.....	\$40 per month.
Do.....	168 Chambers street.....	\$504 per annum.
Do.....	1 room, 18 Broadway.....	\$500 per annum.
Norfolk, Va.....	2 rooms, Carpenter Building.....	\$210 per annum.
Patapsco Station, Md.....	Animal quarantine station.....	\$225 per annum.
Sioux City, Iowa.....	1 room, Live Stock Exchange Building.....	\$20 per month.
South St. Joseph, Mo.....	3 rooms, Live Stock Exchange Building.....	\$45 per month.

OFFICE OF VEGETABLE PATHOLOGICAL INVESTIGATIONS.

Santa Ana, Cal.....	Pacific coast laboratory.....	\$500 per annum.
Miami, Fla.....	United States Tropical Garden, block 100.....	\$5 per month.
Do.....	United States Tropical Garden, block 104.....	Do.
Pike County, Mo.....	Experimental nursery.....	\$50 per annum.

ENTOMOLOGICAL INVESTIGATIONS.

Victoria, Tex.....	Cottage No. 308, Commercial street.....	\$16 per month.
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IRRIGATION INVESTIGATIONS.

Cheyenne, Wyo.....	5 rooms in Warren Block.....	\$60 per month.
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LABORATORY, DEPARTMENT OF AGRICULTURE.

Waycross, Ga.....	Experimental sirup factory.....	\$1 per annum.
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SOIL INVESTIGATIONS.

Lancaster, Pa.....	Soil experiments.....	\$168 per annum.
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## WEATHER BUREAU.

*Stations, with location and annual rental, including such items as heat, light, janitor, ice, brooms, matches, etc.*

Station.	Location.	Rent.	
		Amount.	Includes—
1 Abilene, Tex.....	On South First street.....	\$81.80	Heat, cleaner light, and water.
2 Albany, N. Y.....	In public building, corner Broadway and State street.....		
3 Alpena, Mich.....	Corner Fletcher and Dock streets.....	a 211.36	Heat, cleaner, light, oil, matches, ink, and muelage.
4 Amarillo, Tex.....	In Weather Bureau building, on lots Nos. 8, 9, and 10, block 86, Plemon's addition to Amarillo.....		
5 Asheville, N. C.....	In Library Building, on South Park square.....	a 300.00	Heat, cleaner and oil.
6 Atlanta, Ga.....	In Empire Building, corner Broad and Marietta streets.....	a 1,116.00	Heat, cleaner, light, and ice water.
7 Atlantic City, N. J.....	In Weather Bureau building, corner Rhode Island and Pacific avenues.....		
8 Augusta, Ga.....	In public building, corner Campbell and Greene streets.....		
9 Baker City, Oreg.....	In Pollman Building, Main street.....	a 450.00	Heat, cleaner, light, and water.
10 Baltimore, Md.....	Johns Hopkins University, 582 North Howard street.....		
11 Bessetere, St. Kitts, West Indies.....	In American House, Liverpool Row.....	b 288.00	Observatory platform and storage.
12 Binghamton, N. Y.....	In public building, corner Wall and Henry streets.....	6 120.00	Electric light and telephone.
13 Birmingham, Ala.....	In Walker & Jordan Building, 201 First avenue.....		
14 Bismarck, N. Dak.....	In public building, corner Main and First streets.....		
15 Rock Island, R. I.....	In Island Drug Store Building, on Main street.....	a 231.97	Heat, cleaner, light, oil, matches, ink, muelage, brooms, ice, and use of cellar.
16 Boise, Idaho.....	Roof of Surf Hotel, on Main street.....	b 40.00	For exposure of wind instruments.
17 Boston, Mass.....	In Sonna Building, No. 228 Main street.....	a 480.00	Heat, janitor service, light, hot and cold water.
18 Bridgeport, Barbados, West Indies.....	In public building, Post-Office Square.....		
19 Buffalo, N. Y.....	In Ice House, corner McGregor and Broad streets.....	b 277.00	Cleaner, light, oil, matches, ink, muelage, brooms, ice water, soap, and towels.
20 Buxton, N. C.....	In Prudential Building, corner Pearl and Church streets.....	a 680.00	Heat, cleaner, light, and electric current for motor of printing press.
21 Cairo, Ill.....	In public building, Dare County, N. C.....	b 12.00	Rent of ground.
22 Cape Henry, Va.....	Near Buxton, Dare County, N. C.....		
23 Cape May, N. J.....	In public building, corner Washington avenue and Fourteenth street.....		
24 Carson City, Nev.....	In Weather Bureau building, on the beach.....	a 420.00	Heat, cleaner, and light.
25 Charleston, S. C.....	No. 510 Hughes street.....		
26 Charlotte, N. C.....	In public building, on Carson street.....		
27 Chattanooga, Tenn.....	In public building, 200 East Bay street.....		
28 Cheyenne, Wyo.....	In public building, corner Trade and Mint streets.....		
29 Chicago, Ill.....	In public building, corner Eleventh and A streets.....	a 620.00	Heat, cleaner, light, and water.
30 Cienfuegos, Cuba, West Indies.....	In Commercial Building, 216-218 West Sixteenth street.....	a 1,750.00	Heat, cleaner, light, water, and elevator service.
	Auditorium Building, corner Washash avenue and Congress street.....	b 480.00	Janitor light, water, washing towels, and use of roof.
	In Union Hotel, No. 19 D'Cloud street, corner San Fernando street.....		

31	Cincinnati, Ohio.....	In public building, Fifth street, between Walnut and Main streets.	<i>a</i> 1,140.00	Heat, cleaner, light, oil, matches, ink, muclage, brooms, ice, water, toilet supplies, power for electric motor, gas for stereotyping, electricity for signals, and storeroom.
32	Cleveland, Ohio.....	In Society for Savings Building, corner Public Square and Ontario streets.	<i>a</i> 360.00	
33	Columbia, Mo.....	In Agricultural College Building, campus State University.	<i>a</i> 1,200.00	Heat, cleaner, and light.
34	Columbia, S. C.....	In city hall, northwest corner Main and Gervais streets.	<i>a</i> 300.00	Heat, cleaner, light, gas for stereotyping, electric power for printing press, and ice water.
35	Columbus, Ohio.....	In Hayden Building, 16 and 18 East Broad street.	<i>a</i> 292.00	Heat, cleaner, and light.
36	Concord, N. H.....	In Smith Block, No. 28 Main street.	<i>a</i> 259.00	Heat, cleaner, light, matches, and ice.
37	Concordia, Kans.....	Post-office building, 204 Sixth street.		Heat, cleaner, and light.
38	Corpus Christi, Tex.....	In Hatch and Robertson Building, corner Mesquite and Peoples streets.	<i>b</i> 341.40	Cleaner, electric light, water, ice, and bridge tolls.
39	Curacao, West Indies.....	In Washington Villa, on Hoogstraat.		
40	Curtuck Inlet, N. C.....	In United States life-saving station building.	<i>a</i> 670.00	Heat, cleaner, electric light and power, oil, matches, ink, muclage, brooms, ice, water, soap, and elevator.
41	Davenport, Iowa.....	In public building, corner Fourth and Perry streets.	<i>a</i> 355.65	Heat, cleaner, light, matches, ink, muclage, brooms, ice, water, soap, brushes, stove polish, and lavatory.
42	Denver, Colo.....	In public building, corner Sixteenth and Arapahoe streets.		
43	Des Moines, Iowa.....	In public building, corner Fifth street and Court avenue.	<i>a</i> 72.00	Ground for storm-warning tower.
44	Detroit, Mich.....	Union Trust Building, corner Griswold and Congress streets.	<i>a</i> 288.00	Heat, cleaner, light, and water.
45	Dodge, Kans.....	Beeson Block, on Front street.	<i>a</i> 540.00	Heat, cleaner, electric light for office and for storm warnings, window shades, storage, water, and washstand.
46	Dubuque, Iowa.....	In public building, corner Court avenue and Fifth street.	<i>a</i> 368.80	Heat, cleaner, light, and water.
47	Duluth, Minn.....	In public building, First street and Fifth avenue west.		
48	East Clallam, Wash.....	In telegraph office, Frontier street.		
49	Eastport, Me.....	In public building, corner Water and Washington streets.		
50	Elkins, W. Va.....	In Dunn Building, corner Third street and Davis avenue.		
51	El Paso, Tex.....	In public building, St. Louis and Oregon streets.		
52	Erie, Pa.....	In public building, Park Row and State street.		
53	Escanaba, Mich.....	In Cleary Building, No. 813 Ludington street.		
54	Eureka, Cal.....	In Buhrne's Brick Building, corner Second and G streets.		
55	Evansville, Ind.....	In Federal Building, Second street, between Vine and Sycamore streets.		
56	Flagstaff, Ariz.....	In Milligan Cottage, corner Aspen avenue and Park street.	<i>a</i> 600.00	Heat, cleaner, light, and ice.
57	Fort Smith, Ark.....	In public building, on Sixth street.		
58	Fort Worth, Tex.....	In public building, corner Jennings avenue and Texas street.	<i>a</i> 378.00	Heat, cleaner, and light.
59	Fresno, Cal.....	Farmers' National Bank of Fresno Building, No. 1066 I street.	<i>a</i> 600.00	Heat, cleaner, light, oil, matches, ink, muclage, brooms, ice, water, soap, and towels.
60	Galveston, Tex.....	In Improvement, Loan and Trust Building, 2222 Post-Office street.	<i>a</i> 486.00	Heat, light, and janitor service.
61	Grand Junction, Colo.....	In Canon Block, corner Fourth and Main streets.		Heat, cleaner, light, and water.
62	Grand Rapids, Mich.....	In Michigan Trust Building, corner Ottawa and Pearl streets.	<i>a</i> 1,400.00	
63	Green Bay, Wis.....	In Parmenter Block, 324-328 Washington street.	<i>a</i> 297.00	Cleaner, light, and water.
64	Hannibal, Mo.....	In public building, corner Broadway and Sixth street.		
65	Harrisburg, Pa.....	In public building, corner Third and Walnut streets.		
66	Hartford, N. C.....	In Weather Bureau building.		
67	Havana, Cuba, West Indies.....	At No. 127 Obispo street.	<i>b</i> 300.00	Heat, cleaner, light, matches, brooms, ice, and water.
68	Havre, Mont.....	In Hacienda, between Obispo and Obripiia streets.		
		In Gusenhoven Building, First street, between Third and Fourth avenues.	<i>a</i> 360.00	

*a* In accordance with existing lease.*b* Under written agreement, lease being impracticable.

*Stations, with location and annual rental, including such items as heat, light, janitor, ice, brooms, matches, etc.—Continued.*

Station.	Location.	Rent.	
		Amount.	Includes—
69 Helena, Mont.....	In Power Block, corner Main street and Sixth avenue.....	a \$588.00	Heat, cleaner, and light.
70 Houghton, Mich.....	In Sheldon Building, northwest corner Sheldon and Isle Royale streets.....	a 375.00	Heat, hot and cold water.
71 Huron, S. Dak.....	In Jeffris Block, 337 Dakota avenue.....	a 500.00	Heat, cleaner, light, water, and water-closet.
72 Independence, Cal.....	In Norman House, corner Market and Edward streets.....	a 360.00	Heat, cleaner, light, and water.
73 Indianapolis, Ind.....	In Majestic Building, corner Pennsylvania and Maryland streets.....	a 1,025.00	Heat, cleaner, and light.
74 Ithaca, N. Y.....	In Lincoln Hall, Cornell University.....	a 750.00	Heat, cleaner, and light.
75 Jacksonville, Fla.....	In Deal-Uphurch Building, southeast corner Main and Bay streets.....	a 270.00	Heat, cleaner, light, and water.
76 Juniper, Fla.....	In Weather Bureau building, near light-house.....	a 660.00	Heat, cleaner, light, brooms, ice water, and water.
77 Kalspel, Mont.....	In Corned National Bank Building, corner Main and Second streets.....	.....	.....
78 Kansas City, Mo.....	In Rialto Building, corner Grand avenue and Ninth street.....	.....	.....
79 Keokuk, Iowa.....	In public building, corner Seventh and Blendean streets.....	.....	.....
80 Key West, Fla.....	In Weather Bureau building, corner Eaton and Front streets.....	b 96.00	Boathouse for storage of Weather Bureau launch.
81 Kittyhawk, N. C.....	On water front near Front street.....	.....	.....
82 Knoxville, Tenn.....	In University of Tennessee.....	.....	.....
83 La Crosse, Wis.....	In public building, corner Fourth and State streets.....	a 351.00	Heat, cleaner, and light.
84 Lander, Wyo.....	In Dent Lumber Company Building, 36 Main street.....	a 420.00	Heat, light, water, use of toilet, washstand, use of roof, and janitor service.
85 Lewiston, Idaho.....	In Front and Butler Building, 319 E street.....	.....	.....
86 Lexington, Ky.....	In State College Building, South Limestone street.....	.....	.....
87 Lincoln, Nebr.....	In University of Nebraska Building, corner Twelfth and T streets.....	.....	.....
88 Little Rock, Ark.....	In public building, on Second street, between Center and Spring streets.....	a 780.00	Heat, cleaner, and light.
89 Los Angeles, Cal.....	In Trust Building, northeast corner Spring and Second streets.....	a 256.00	Heat, cleaner, light, and water
90 Louisville, Ky.....	In public building, corner Fourth and Chestnut streets.....	b 12.00	Rent of ground.
91 Lynchburg, Va.....	In Law Building, 807 Main street.....	a 360.00	Heat and water.
92 Macon, Ga.....	In public building, corner Third and Mulberry streets.....	.....	.....
93 Mantoo, N. C.....	At Weirs Point, near Mantoo, N. C.....	.....	.....
94 Marquette, Mich.....	In Marquette County Savings Bank, southeast corner Washington and Front streets.....	a 600.00	Heat, cleaner, light, water, and elevator.
95 Memphis, Tenn.....	In Porter Building, corner Main and South Court streets.....	a 300.00	Heat, cleaner and light.
96 Meridian, Miss.....	In public building, corner Twenty-second avenue and Eighth street.....	.....	.....
97 Miles City, Mont.....	In Leighton Building, on Main street.....	.....	.....
98 Milwaukee, Wis.....	In public building, Wisconsin street, between Jefferson and Jackson streets.....	.....	.....
99 Minneapolis, Minn.....	In public building, corner Third street and First avenue, south.....	.....	.....
100 Mobile, Ala.....	In public building, corner St. Francis and Royal streets.....	.....	.....
101 Modena, Utah.....	In Weather Bureau building, about 850 feet southwest of Oregon Short Line R. R. depot.....	.....	.....
102 Montgomery, Ala.....	In public building, corner Lawrence street and Dexter avenue.....	.....	.....



103	Moorehead, Minn.....	In First National Bank, corner Front and Sixth streets.....	a 255.25	Heat, cleaner, light for office, matches, ink, muelage, brooms, ice, water, and soap.
104	Mount Tamalpais, Cal.....	In Observatory building, eastern peak Mount Tamalpais.....	a 420.00	Heat, light, water, and transportation for employees and supplies.
105	Mount Washington, N. H.....	On summit.....	a 5.00	For rent of ground on which Weather Bureau building is located.
106	Nantucket, Mass.....	In Pacific Club House, corner Main and Water streets.....	a 293.00	Heat, light, and water.
107	Narragansett Pier, R. I.....	In Odlen Cottage, Kingstown street.....	a 150.96	Heat, light, matches, ink, muelage, and brooms.
108	Nashville, Tenn.....	In Chamber of Commerce, No. 399 Church street.....	b 500.00	Heat, cleaner, and light.
109	Nash Bay, Wash.....	In Indian agency building, facing bay.....		
110	New Haven, Conn.....	In insurance building, No. 890 Chapel street.....	a 384.00	Heat, cleaner, and light.
111	New Orleans, La.....	In public building, corner Decatur and Customhouse streets.....		
112	New York, N. Y.....	In American Surety Building, 100 Broadway.....	a 3,500.00	
113	Norfolk, Va.....	In Citizens' Bank Building, 191-195 Main street.....	a 525.00	Heat, cleaner, light for office and signals, electricity or gas for stereotyping, electric current for printing press, use of flagstaff, elevators, roof, and storage for property.
114	Northfield, Vt.....	In Norwich University, on Central street.....		Heat, cleaner, electric light for office and storm signals, and ice water.
115	North Head, Wash.....	In Weather Bureau building.....	a 333.50	Heat, cleaner, light, matches, ink, muelage, brooms, ice, and soap.
116	North Platte, Nebr.....	In Odd Fellows' Hall, corner Fifth and Dewey streets.....	a 510.00	Heat, cleaner, light, and water.
117	Oklahoma, Okla.....	In Culbertson Building, corner Broadway and Grand avenue.....		
118	Omaha, Nebr.....	In public building, corner Sixteenth and Dodge streets.....		
119	Oswego, N. Y.....	In public building, Oneida street.....	a 314.00	Heat, cleaner, light, oil, matches, ink, muelage, brooms, ice, water, and soap.
120	Palestine, Tex.....	In City Hall, corner of Palmer and Oak streets.....		
121	Parkersburg, W. Va.....	In public building, corner Fifth and Juliana streets.....		
122	Pensacola, Fla.....	In public building, corner Palafox and Government streets.....		
123	Philadelphia, Pa.....	In public building, corner Ninth and Chestnut streets.....	a 480.00	Water-closet and lavatory.
124	Phoenix, Ariz.....	In Talbot Building, corner north First avenue and Adams street.....	a 240.00	Heat, light, matches, ink, muelage, brooms, ice, water, and soap.
125	Pierre, S. Dak.....	In Geiger's Block, Pierre street, near Dakota avenue.....		
126	Pittsburg, Pa.....	In public building, Smithfield street, Third to Fourth avenues.....	a 360.00	Heat, cleaner, light, and water.
127	Pocatello, Idaho.....	In Cook Building, 343 west Center street.....		
128	Point Reyes, Cal.....	In Weather Bureau building.....		
129	Port Crescent, Wash.....	do.....		
130	Port Huron, Mich.....	In Federal Building, corner Sixth and Water streets.....		
131	Portland, Me.....	First National Bank, 57 Exchange street.....	a 504.00	Heat, cleaner, light, oil, matches, ink, muelage, brooms, ice, and soap.
132	Portland, Oreg.....	In public building, corner Davis and north Seventh streets.....		
133	Pueblo, Colo.....	In public building, corner Sixth and Main streets.....	b 300.00	Janitor service and water.
134	Puerto Principe, Cuba, West Indies.....	In San Francisco college, San Francisco square.....	a 240.00	Water rent for water-closet.
135	Raleigh, N. C.....	In Fisher Building, corner Fayetteville street and Exchange place.....	a 378.00	Heat, cleaner, light, and water.
136	Rapid City, S. Dak.....	In Lakota Building, corner Seventh and St. Joe streets.....	a 396.25	Heat, cleaner, light, oil, matches, ink, muelage, brooms, ice, and soap.
137	Red Bluff, Cal.....	In bank of Tehama County, Cal., corner of Main and Walnut streets.....	a 600.00	Heat, cleaner, light, water, elevator, electric power for press, and gas for stereotyping furnace.
138	Richmond, Va.....	In Times Building, corner Bank and Tenth streets.....		

a In accordance with existing lease.

b Under written agreement, lease being impracticable.

*Stations, with location and annual rental, including such items as heat, light, janitor, ice, brooms, matches, etc.—Continued.*

Station.	Location.	Rent.	
		Amount.	Includes—
139 Rochester, N. Y. ....	In public building, corner Church and Fitzhugh streets.		Heat, cleaner, light, and water.
140 Roseburg, Oreg. ....	In Marks Building, 228½ Jackson street.	<i>a</i> \$339.00	Use of roof for exposure of instruments.
141 Rosau, Dominica, West Indies. ....	In Hotel De Garcon, corner Long Lane and Bow Lane.	<i>b</i> 36.00	
142 Sacramento, Cal. ....	In public building, corner Seventh and K streets.		Heat, cleaner, light, and water.
143 St. Louis, Mo. ....	In Chemical Building, corner Eighth and Olive streets.	<i>a</i> 1,800.00	Heat, cleaner, light, water, and elevator.
144 St. Paul, Minn. ....	In Chamber of Commerce Building, 112 East Sixth street.	<i>a</i> 372.85	Heat, cleaner, light, oil, matches, ink, mucilage, brooms, ice, soap, and chimneys.
145 Salt Lake City, Utah. ....	In Dooly Block, corner west Temple and Second South streets.	<i>a</i> 600.00	Heat, cleaner, light, matches, brooms, water, and elevator.
146 San Antonio, Tex. ....	In Hicks Building, corner Avenue C and East Houston street.	<i>a</i> 480.00	Heat, cleaner, light, and water.
147 San Diego, Cal. ....	In Keating Building, corner Fifth and F streets.	<i>a</i> 384.00	Heat, cleaner, light, and water.
148 Sand Key, Fla. ....	In Weather Bureau building, near light-house.		
149 Sandusky, Ohio. ....	In public building, corner Columbus avenue and Market street.		
150 San Francisco, Cal. ....	In Mills Building, corner Bush and Montgomery streets.	<i>a</i> 2,490.00	Heat, cleaner, light, water, electric power for printing press, and gas for stereotyping.
151 San Juan, P. R., West Indies. ....	No. 5 Allen street.	<i>a</i> 600.00	Water.
152 San Luis Obispo, Cal. ....	In Crocker Building, corner Garden and Higuera streets.	<i>a</i> 300.00	Heat, cleaner, light, and water.
153 Santa Fe, N. Mex. ....	In Carron Building, corner Plaza on Palace avenue.	<i>a</i> 420.00	Heat, light, and water.
154 Santiago de Cuba, West Indies. ....	In Provincial Institute on Trinidad street.		
155 Santo Domingo, S. D., West Indies. ....			
156 Sault Ste. Marie, Mich. ....	In Weather Bureau building on Government reservation known as "Canal grounds."		
157 Savannah, Ga. ....	In public building, corner President and Whitaker streets.		Heat, cleaner, and light.
158 Scranton, Pa. ....	In Connell Building, 127 Washington avenue.	<i>a</i> 475.00	Heat, cleaner, light, and water.
159 Seattle, Wash. ....	In New York Building, No. 704 Second avenue.	<i>a</i> 480.00	
160 Shreveport, La. ....	In public building, corner Texas and Marshall streets.		
161 Sioux City, Iowa. ....	In public building, corner Sixth and Douglas streets.		
162 Southeast Farallone, Cal. ....	In Weather Bureau building.		
163 Spokane, Wash. ....	In Empire State Building, corner Lincoln street and Riverside avenue.	<i>a</i> 660.00	Heat, cleaner, light, and water.
164 Springfield, Ill. ....	In public building, corner Monroe and Sixth streets.		
165 Springfield, Mo. ....	In public building, corner Boonville and Brower streets.		
166 Syracuse, N. Y. ....	In Syracuse University.		Heat, cleaner, and light.
167 Tacoma, Wash. ....	In Chamber of Commerce Building, corner C and Ninth streets.	<i>a</i> 300.00	Heat, cleaner, light, matches, ink, mucilage, and ice.
168 Tampa, Fla. ....	In Knight Building, No. 315½ Franklin street.	<i>a</i> 328.75	
169 Tatoosh Island, Wash. ....	In Weather Bureau building.		Heat, cleaner, light, and water.
170 Taylor, Tex. ....	In Taylor National Bank Building, 200 Main street.	<i>a</i> 675.00	
171 Toledo, Ohio. ....	In public building, corner Madison and St. Clair streets.		Heat, cleaner, light, and water.
172 Topeka, Kans. ....	In Columbian Building, 112 West Sixth avenue.	<i>a</i> 500.00	Heat, cleaner, light, and water.

173	Twin, Wash.....	In Jones Building.....	a 100.00	Heat, cleaner, light, water, and water-closet.
174	Valentine, Nebr.....	In Fraternal Hall Building, on Main street.....	a 420.00	
175	Vicksburg, Miss.....	In public building, corner Crawford and Walnut streets.....		Heat, cleaner, and light.
176	Walla Walla, Wash.....	In Paine Brothers Building, corner Main and Second streets.....	a 310.80	Heat, cleaner, and light.
177	Wichita, Kans.....	In The Sedgewick, corner First and Market streets.....	a 340.00	Heat, cleaner, and light.
178	Wilmington, N. Dak.....	In Baldwin Cottage, corner Main and Seventh streets.....	a 480.00	Heat, cleaner, light, and water.
179	Wilmington, N. C.....	In public building, corner Front and Chestnut streets.....		
180	Winnemucca, Nev.....	In county court-house, on Bridge street.....	a 298.00	Heat, cleaner, light, matches, ink, muelage, brooms, and water.
181	Wytheville, Va.....	In Bank of Wytheville Building, Main street between Second and Fourth avenues.....	a 400.00	Heat, cleaner, and light.
182	Yankton, S. Dak.....	In Wagner Block, 307 and 309 Walnut street.....	a 300.00	Heat, light, and janitor service.
183	Yuma, Ariz.....	In public building, on Government reservation.....		
	Total.....		50,593.34	

a In accordance with existing lease.

b Under written agreement, lease being impracticable.





## REPORT OF THE EDITOR, DIVISION OF PUBLICATIONS.

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U. S. DEPARTMENT OF AGRICULTURE,  
DIVISION OF PUBLICATIONS,  
*Washington, D. C., September 15, 1903.*

SIR: I have the honor to submit herewith, for your information and consideration, a report on the work of this Division for the fiscal year ended June 30, 1903, together with recommendations in regard to future operations.

Respectfully,

GEO. WM. HILL,  
*Editor and Chief.*

Hon. JAMES WILSON, *Secretary.*

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### WORK OF THE YEAR, WITH RECOMMENDATIONS.

#### • GROWTH OF THE WORK OF THE DIVISION.

During the many years that I have had the honor to report on the work of the Division of Publications I have had to state each year that the work of the Division has been characterized by unceasing activity, and has shown a marked increase over the previous year, but in no one year hitherto has the increase in the publication work of the Department of Agriculture been so marked as in that covered by the present report. It is indeed remarkable that the past year shows not only a greater aggregate increase, but a greater percentage of increase than any of its predecessors. The largest number of publications issued in any one year heretofore was 757 in 1902. The total number of publications issued during 1903 amounts to 938. Of these, 375 were new publications, against 355 new publications in 1902. The total new matter edited in the Division comprised over 21,000 pages, an increase over the previous year of more than 17 per cent. The total number of copies of all publications issued during the year aggregated 11,698,564, more than 1,100,000 over last year. The total number of requisitions for printing issued on the main office of the Government Printing Office was 1,203, against 1,014 the year previous, and the requisitions drawn upon the branch office numbered 3,356, as against 2,500 the previous year. All of this work was accomplished at an increase of expense far less in proportion than the increase of work. This of itself evidences the increasing efficiency of our force and the cheerful alacrity with which the individual members have contributed extra time to the work. In spite of all this, however, and of continued efforts toward economy, it was found necessary toward the close of the fiscal year to appeal for aid to other Bureaus and Divisions of the Department in order to avoid any check in the work of distribution of documents. The appropriations for the current fiscal year are practically the same as for last year, and the experience of the

first few months has made it already plain that to accomplish the work with which we are confronted for this current year will severely tax our ingenuity.

#### NECESSITY FOR INCREASED APPROPRIATIONS.

It is, under these circumstances, my plain duty to make an earnest appeal for an increase in the appropriations for the use of this Division for the fiscal year ending June 30, 1905. For reasons already stated, I am convinced that you will cordially indorse this appeal. The fact that the increase asked for but slightly exceeds 6 per cent of the general appropriation is evidence of the conservative character of the estimates for the ensuing year.

#### ESTIMATES FOR THE DIVISION.

In this connection, I can not make the situation clearer than by transcribing here the memorandum submitted with my estimates for the ensuing year, to which your favorable consideration has already been invited:

The estimates for the ensuing year for this Division provide for an increase of \$12,720, considerably less than 6 per cent. During the past two years, want of adequate provision to meet the increase of work has made it necessary to ask for a deficiency appropriation, besides obtaining considerable financial aid toward the close of each fiscal year from other Bureaus and Divisions—aid which is necessarily precarious. The work of this Division is a reflection of the increased activities, the extension, and the development of the Department; hence its increase is necessarily continuous from year to year.

The total number of publications prepared and issued under the supervision of this Division last year was 857, an increase over the preceding year of 185. The increase in the total number of documents printed was 1,000,000, in round numbers, and there was an increase of 1,000,000 in the number of documents distributed. The total number of requisitions made on the Public Printer during the year, for as many different jobs, was 4,559, an increase of 1,045, or very nearly 30 per cent, over the previous year.

The experience of the current year so far justifies the anticipation of continued increase, so that even if the increase asked for be granted it will require systematic and rigid economy to meet necessary expenses.

The experience of the past year shows that the Editor and his principal assistants are seriously overtaxed, and in spite of every effort, and the contribution by all the responsible employees of extra time, equal to if not exceeding the usual term of annual leave, the editorial work is in some respects slighted. Additional force is therefore asked for to the extent of one editor, one chief clerk, and one second assistant in the document section. This increase is partially offset by the omission of two copyists, at \$840 each, and one editorial clerk, at \$1,400. The assignment to some of the Bureaus and Divisions of editorial assistants and editors makes it desirable that the Editor and Chief of this Division should be known as the Editor in Chief and some of his principal assistants as editors. In view of the responsibilities devolving upon this Division, it is a matter of consequence that its editorial supremacy in the Department should be thus recognized.

The large amount of bookkeeping, the great increase in correspondence, the supervision of the more than 3,000 requisitions on the branch office, of numerous orders for supplies, and the general control and supervision of more than 150 employees, with records of their annual and sick leaves, and of the frequent details to other Bureaus, Divisions, and Offices, make it extremely important that there should be a chief clerk in the Division, who shall relieve the chief and his first assistant from the flood of detailed and routine work, which at present tends greatly to distract their attention from the most important—that is, the editorial—work of the Division. A great deal of this purely administrative work now devolves upon the chief himself, which is poor economy.

#### RELATION OF THE DIVISION TO OTHER BRANCHES OF THE DEPARTMENT.

In connection with this increase of work and an appeal for a small addition to the funds necessary to carry it on, it becomes necessary



for me to emphasize once more that the extent and growth of the publication work of the Department are not controllable by the chief of this Division. The work he has to dispose of is that which comes to him, and the more the general work of the Department is enlarged and developed the more does that work increase through which its results are made available to the general public—work which is all done through this Division. The only economy, therefore, which the writer can exercise in carrying on the work devolving upon him is in carefully systematizing it and avoiding all possible waste.

Taking the figures showing the growth of this Division as fairly representative of the general growth of the Department at large, it is certainly very significant that the total number of publications issued during the fiscal year 1903 should be just two more than double the number issued during the fiscal year 1900. The increase in the total number of copies of all publications issued during the same period aggregates 4,500,000+.

#### ADDITION TO THE EQUIPMENT OF THE DIVISION.

An important addition to the equipment of the Division has been made in the illustration section by the acquisition and establishment, in a room being prepared for the purpose, of a complete photographic plant, which is for the first time on a scale adequate to our requirements. Considerable new apparatus has been installed, among which may be mentioned the following: A 22 by 27 camera for copying, reducing, and enlarging, and an 8 by 10 camera for outside photographic work. With the additional quarters which have been secured it will be possible to do all kinds of printing, such as platinum, velox, gelatine, and bromide, up to 26 inches; also to make lantern slides. This apparatus, in addition to that already possessed by the Division, gives it a very complete and excellent outfit with which general photographic work may be done. We are availing ourselves of photographic work more and more to save the time of artists and draftsmen, in which, even with our inadequate facilities, we have been fairly successful. There will now be at our command permanent means to effect a saving equal to the salaries of two draftsmen at least.

#### PUBLICATIONS ORDERED BY CONGRESS.

The publications of this Department printed by special Congressional order were the following:

- (1) Annual reports of the Department of Agriculture for the fiscal year ended June 30, 1902.
- (2) Yearbook of the Department of Agriculture, 1902.
- (3) Report of the Chief of the Weather Bureau, 1901-1902.
- (4) Eighteenth Annual Report of the Bureau of Animal Industry for the year ended June 30, 1902.
- (5) Field Operations of the Bureau of Soils, 1901.
- (6) Annual Report of the Office of Experiment Stations for the year ended June 30, 1902.
- (7) Message of the President of the United States, transmitting a report by the Secretary of Agriculture of the Operations of the Bureau of Animal Industry of that Department for the fiscal year ending June 30, 1902.
- (8) A Message from the President of the United States, transmitting a report of the Secretary of Agriculture in relation to the forests, rivers, and mountains of the Southern Appalachian region.

The majority of these publications appear regularly yearly, and are provided for in the general appropriation for the public printing and binding. In most of these cases provision is made for a quota for the Department of Agriculture, as well as for the Senate and House of Representatives. One of the exceptions in this respect was the Annual Report of the Office of Experiment Stations, of which only a small number was ordered printed, sufficient for the actual use of Senators and Representatives, but inadequate to any general distribution, and no provision was made for supplying the Department of Agriculture. A special resolution was prepared and presented by the honorable chairman of the House Committee on Printing providing for 5,000 copies for the use of the Department, but this failed to receive the favorable action of the House. Other publications which it was sought to provide for by special resolutions in Congress were a reprint of the Primer of Forestry, also of the Woodsman's Handbook, and of the Report of Irrigation Investigations in Utah. The number of applications for these publications from Senators and Representatives was so great and did so much to exhaust the first editions that it was believed that Congress would be willing to provide a further supply, and I still believe that such is the case, and that the resolutions failed mainly from the fact that pressure of business in the House precluded their favorable consideration.

#### LAW RELATING TO SIZE OF EDITIONS OF PUBLICATIONS.

Every year several valuable publications, the printing of which has been asked for of Congress under the provisions of section 89 of the "Act providing for the public printing and binding," approved January 12, 1895, go unprinted for want of Congressional action, and very often those omitted are of the first importance. If the section referred to could be amended and the clause limiting the Secretary's discretion in the case of publications exceeding 100 octavo pages revoked, these appeals to Congress would be very rarely necessary. In almost every case this would result in economy; for the number printed would be necessarily limited to our actual necessities, and it would not be necessary to make a special provision, as now happens in all these cases, for distribution by Senators and Representatives. On the other hand, in case of any publication creating a demand beyond the power of the Department, with its limited printing appropriation, to supply, a reprint for Congressional use could at any time be had. In the case of reports which by their nature are of considerable size and importance, and appear yearly, it would be extremely desirable that Congress should provide for such, as is now done for the Annual Reports of the Department, the Yearbook, the Report of the Bureau of Animal Industry, etc., so that they could be turned over to the Public Printer as soon as ready, and a special appeal to Congress year after year be avoided. In the case of the Report of the Office of Experiment Stations, only a small number of which was ordered printed, it became necessary for the Secretary to order a special edition for the use of the Department, which, owing to the provisions of the law already referred to, was limited to 1,000 copies—a number quite inadequate for even the most judicious and conservative distribution. I earnestly recommend that the clause in section 89 of the "Act providing for the public printing and binding, and the distribution of public documents," which limits the Secretary's discretion as to the

size of editions of publications exceeding 100 octavo pages, be rescinded. The basis of this limitation is evidently an illogical one. The size of the edition and character of the distribution should obviously depend upon the character of the matter published and not upon the number of pages contained in the publication.

#### A NOMINAL CHARGE FOR PUBLICATIONS.

The question of the size of the edition of the publications and several other problems confronting us in the future development of the work of the Department could be satisfactorily met and solved by the plan so frequently recommended in my previous reports, that a trifling price be affixed to each publication, sufficient to secure its distribution only to people really desiring or needing the same. This would serve to accumulate a fund in the hands of the Public Printer which could be devoted, under proper limitations and with the concurrence of the Secretary of Agriculture, to the reprinting of such of our publications as continued to be called for. As a matter of fact, the Superintendent of Documents does actually, even under present conditions, receive several thousand dollars yearly for publications of this Department sold by him, and he reports that he could sell a great many more of them were the Department able to supply them. It not infrequently happens that a reprint of some publication is ordered solely in consequence of the appeals of the Superintendent of Documents for additional copies to supply the demands made upon him. It is obvious that in such cases the cost of the reprint should be charged not to the restricted and often inadequate appropriation for printing for this Department, but to the sums turned into the Treasury by the Superintendent of Documents as the proceeds of our publications.

#### ADDITIONAL OFFICE ROOM SECURED.

It is gratifying to note that an additional room has been assigned to the use of this Division, located directly above the business office, with which it is connected by an elevator for the transmission of proofs and manuscripts and a speaking tube. In this room most of the editorial work and proof reading is done. This arrangement has relieved the congestion heretofore existing in the main office and contributes very greatly to the convenience and hence to the efficiency of the employees, providing what the Division has long needed and desired, namely, an editorial room devoted exclusively to such work.

#### DISCONTINUANCE OF THE ROYAL OCTAVO.

One of the important features of the publication work of the year was the decision of the Secretary to discontinue the use of the royal octavo size for any of the bulletins issued by the Department. This size had been adopted by the Bureaus of Forestry, Plant Industry, and Chemistry, and there was a preference for it by certain other Divisions and Offices, while some were strongly in favor of adhering to the regular octavo. It developed in the consideration of the subject that the expense of the royal octavo was about 20 per cent more than the octavo, without a corresponding improvement in general utility. In view of this fact, and also of the importance of securing uniformity in the size of the bulletins and reports, the decision to return to the octavo was adopted. The quarto size will be continued in the series



already begun where extended tables and illustrations of unusual sizes are necessary.

#### DOCUMENT SECTION.

The work of caring for and distributing the publications of the Department of Agriculture during the fiscal year ended June 30, 1903, has, owing to the improved organization of the office and the better systematizing of the work, been performed with more than usual efficiency and dispatch, the publications being distributed with great promptness, although the amount of clerical, semiclerical, and manual work has necessarily been greater than during preceding years. The efficiency and faithfulness of the force employed is worthy of commendation and speaks well for their loyalty to the office and the willingness with which the increased labor has been performed.

During the twelve months just ended more work has been taken on in the document section from the various Bureaus, Divisions, and Offices of the Department in the line of preparing franks from the lists kept in the several Divisions than in previous years. The methods of bookkeeping and card indexing have been improved and brought to a higher state of efficiency, so that with very little expenditure of time reference can be made to the mailing of almost any document.

The Public Printer has delivered 6,845,626 Farmers' Bulletins, and there were 2,226,977 copies on hand July 1, 1902. Of these, 3,954,976 copies were forwarded at the request of Senators, Representatives, and Delegates, under their franks, and 1,592,003 were forwarded to miscellaneous applicants, whose requests were sent directly to the Department. There are now on hand in the storage rooms of the Division 3,525,624 Farmers' Bulletins available for use in forming new quotas for allotment to Members of Congress. Of publications other than Farmers' Bulletins, 3,685,925 were received from the Public Printer and 3,659,552 were mailed from this section in response to applications or in supplying persons whose names are borne on the lists kept in the various offices of the Department. Of these, only 48,120 were distributed upon the requests of Senators, Representatives, and Delegates, showing a distribution of 3,611,432 to applicants whose requests were made directly to the Secretary.

The correspondence work devolving upon the assistant in charge has largely increased, as will be noted from the fact that there were 22,223 letters dictated and prepared for the signature of the Secretary or the chief of the Division, as against 16,792 during the previous fiscal year. These comprise but a portion of the replies to correspondents, as wherever possible printed blanks and notification slips are used in order to economize the time of the stenographers and clerks detailed to that work.

The two additional rooms secured for the use of the assistant in charge and the clerks engaged in handling the correspondence and keeping the books of the document section have contributed greatly to the comfort of the employees and afforded increased facilities for attending to their duties. There is still need, however, for more storage room, in order to properly arrange and protect the large number of publications constantly on hand, also that those engaged in the actual work of folding and mailing the Department's publications may not be compelled to frequently rearrange the documents on hand to make space for new publications where they will be most convenient to the workroom.

The increase of work in this section necessitated an effort to relieve the situation, and Mr. Cleary, for many years bookkeeper and requisition clerk of the Division, was assigned as an assistant to Mr. Handy, who is in charge of the section. It is gratifying to report that Mr. Cleary's experience and efficiency have contributed greatly to lighten the burden.

## DISTRIBUTION OF PUBLICATIONS ABROAD.

Radical changes have occurred during the year in the distribution of publications abroad, with the object of reducing to a minimum the number so mailed. Generally speaking, no names of individuals are to be put on the lists of any Bureau, Division, or Office, but the monthly list of publications will be sent to them. This will furnish the titles of the bulletins and reports and the prices at which the same may be obtained of the Superintendent of Documents. Only institutions of learning and libraries of recognized standing will be allowed to receive the publications as issued, and the total number of such names on the lists of the Bureaus, Divisions, and Offices shall not exceed 2,000. No request from an individual in a foreign country will be honored without the authority of the Secretary. The following orders upon this subject were issued:

General Order No. 64.

## DISTRIBUTION OF PUBLICATIONS ABROAD.

U. S. DEPARTMENT OF AGRICULTURE,  
OFFICE OF THE SECRETARY,  
*Washington, D. C., January 19, 1903.*

It is hereby ordered that the number of libraries and other institutions on the foreign exchange list of this Department maintained in the Library be reduced and hereafter limited to 2,000, and that no list of any single Bureau or Division included therein shall exceed 200.

No list of foreign individuals shall be kept, to whom publications of the Department are sent, except for the purpose of mailing to them the monthly list, and all such applicants shall be advised that the publications to which a price is attached are to be obtained by purchase from the Superintendent of Documents.

The general consular list is also abolished; any consular distribution desired must be on a list specially prepared for each publication and must be approved by the Secretary.

Hereafter no request for any publication of this Department received from any individual in a foreign country shall be honored without the express authority of the Secretary.

JAMES WILSON, *Secretary.*

General Order No. 66.

## MISCELLANEOUS FOREIGN REQUESTS.

U. S. DEPARTMENT OF AGRICULTURE,  
OFFICE OF THE SECRETARY,  
*Washington, D. C., March 7, 1903.*

Hereafter miscellaneous foreign requests for publications of the Department (outside of regular mailing lists) will be referred to the Librarian for attention.

From estimates furnished by chiefs of Bureaus and Divisions it appears that the present requirements in this direction are:

	Requests per month.		Requests per month.
Bureau of Animal Industry .....	15	Division of Biological Survey.....	10
Bureau of Soils.....	12	Division of Publications.....	5
Bureau of Chemistry .....	10	Division of Library .....	5
Bureau of Plant Industry .....	20	Division of Foreign Markets.....	10
Bureau of Forestry .....	25	Division of Road Inquiry .....	10
Office of Experiment Stations .....	25	Division of Statistics.....	0
Division of Entomology.....	10		

The Librarian is authorized to honor requests of this character to the extent set forth above. Not more than one publication shall be sent in response to any one request, except when a Bureau or Division has not exhausted in any one month its allotment as given above. Any unused credit in one month may be carried over to a succeeding month.

Chiefs of Bureaus and Divisions will obtain from the Librarian blank slips, numbered consecutively. Each request transmitted shall be accompanied by one of these slips, properly filled out, and the Librarian will keep account with each Bureau and Division on the above basis.

JAMES WILSON, *Secretary*.

These orders led to a general revision of all foreign lists, and the copies of publications, more especially the Yearbook, saved from the foreign distribution were made available for domestic use.

#### THE YEARBOOK FOR 1902.

The Yearbook for 1902 was delivered May 29, 1903. It contains 912 pages and is illustrated by 87 plates and 62 text illustrations, while the number of separate articles is 37, besides the Appendix. In the number and variety of articles it surpasses any volume yet issued. The edition is 500,000 copies, of which the Department's allotment is only 30,000, quite insufficient to supply regular correspondents and divisional lists, leaving absolutely none for miscellaneous distribution. All miscellaneous applicants are of necessity referred to Senators, Representatives, and Delegates in Congress. To supply our actual requirements, therefore, an increase of the Department's quota to at least 50,000 copies is again earnestly recommended.

During the last session of Congress a resolution was offered providing an appropriation of \$10,000 to furnish additional Yearbooks, from which the Secretary of Agriculture should supply one copy each to all students following the agricultural course in the several land-grant colleges. The number of additional copies to the Department's quota recommended above would not cost much, if any, more than the \$10,000 appropriated by the resolution in question, and the distribution to students in agriculture contemplated thereby could be carried out. I should recommend, therefore, that the printing bill be amended so as to provide at least 20,000 extra copies of the Yearbook for the use of this Department, including a distribution to students in agriculture at the land-grant colleges.

#### SOME USES OF THE APPENDIX TO THE YEARBOOK.

The Appendix to the Yearbook is the only means now available of placing permanently on record the complete annual statistics prepared by the Bureau of Statistics. This record includes the annual production, by States, and total production, by years, of corn, wheat, oats, barley, potatoes, tobacco, cotton, and other crops; the annual enumeration and valuation of horses, cattle, hogs, and sheep; also tables of prices in the great markets, and of transportation rates.

The several Bureaus, Divisions, and Offices of the Department also find it a convenient place to give a succinct statement of the year's progress of each for the use of students of all classes throughout the country. It is so used by the Bureaus of Forestry, Plant Industry, Soils, and Animal Industry, the Weather Bureau, and by several of the other offices.

The Yearbook is available for reference in hundreds of libraries where no other Government publication is kept. It constitutes a continuation of the series of agricultural reports begun by the Patent



Office and merged into the Annual Reports of the Commissioner of Agriculture, which form the lasting record of the growth of the Department of Agriculture. These have all contained in a large measure the matter now placed in the Appendix. The first publication of any length in this series consists mainly of crop statistics.

In this part of the Yearbook the lists of agricultural colleges and experiment stations, with the directory of the Department of Agriculture and of the State bureaus and agricultural societies and livestock organizations, etc., are presented in a form for easy reference, and have become, it is believed, the usual source for information of this kind to thousands of persons in every center of population, and to progressive farmers generally. They are not to be found in any other publication of a permanent character. Many publishers of newspapers and periodicals would be at a loss for means to continue their study and review of public questions if deprived of the information annually supplied in this form. Young men and women looking forward to a study of agriculture find in the tables of studies a means of determining what college they can most profitably attend.

The statements in the Appendix regarding public lands are found useful, as shown every year by inquiries, which can be best answered by sending these statements. The miscellaneous information presented is selected with care, and is intended to be valuable to readers generally, but especially to farmers.

The special articles in the Yearbook are not, in my opinion, as essentially a part of the publication as is the compendium of useful information gathered together in the Appendix, and which should be available in this form on the farmers' bookshelves or in our libraries. The articles might just as well be printed in a quarterly magazine; but it is the Appendix, together with the Secretary's report, that gives the volume the characteristics of a true agricultural yearbook—an annual summary of valuable information for farmers.

#### INTERPRETATION OF THE PRINTING LAW REGARDING INDEX CARDS.

The matter of procuring index cards by contract from the lowest bidder having come up in the Department early in the year, the Comptroller of the Treasury was requested to interpret the printing law requiring that "all printing, binding, and blank books" be done at the Government Printing Office, and that officer decided that there was no authority for procuring any printing from private establishments. In accordance with this decision the following general order was issued from the office of the Secretary:

General Order No. 57.

INDEX CARDS AND OTHER PRINTING TO BE OBTAINED FROM THE GOVERNMENT  
PRINTING OFFICE.

U. S. DEPARTMENT OF AGRICULTURE,  
OFFICE OF THE SECRETARY,  
Washington, D. C., August 1, 1902.

*To officers and employees of the Department of Agriculture, and others concerned:*

Attention is directed to the following decision of the Comptroller of the Treasury:

TREASURY DEPARTMENT,  
OFFICE OF COMPTROLLER OF THE TREASURY,  
Washington, D. C., July 18, 1902.

SIR: In your communication of the 18th instant you request my decision of a question presented by you as follows:

"The Department, being about to inaugurate an extensive card-index system in one of the divisions of the Secretary's Office, has obtained estimates for the work from the Public Printer and an outside concern. The Public Printer's estimate amounts to \$1,230.08, while the other estimate amounts to \$755.

"Section 3786, Revised Statutes of the United States, provides that 'all printing, binding, and blank books for the Senate or House of Representatives, and the Executive and Judicial Departments shall be done at the Government Printing Office, except in cases otherwise provided by law.'

"Would the Department be authorized to award the contract for the work to the low outside bidder in this case, and charge the cost to an appropriation other than that provided for the public printing and binding?"

It is understood that the cards to be used in the card-index system in contemplation require printing.

The provision quoted by you from section 3786 of the Revised Statutes was reenacted in the act of January 12, 1895 (28 Stat. L., 622). It is a positive requirement that all printing for the Executive and other Departments shall be done at the Government Printing Office, unless otherwise provided by law, and impliedly prohibits these Departments from procuring printing not otherwise provided for to be done elsewhere. It does not admit of any exception upon grounds of economy or expediency, but it is comprehensive and exclusive.

I am not aware of any provision of law authorizing printing for this Department to be done elsewhere, and I have therefore to advise you that you are not authorized to have the cards which you contemplate procuring printed by any private establishment.

Respectfully,

R. J. TRACEWELL, *Comptroller.*

The SECRETARY OF THE TREASURY.

Hereafter in obedience to the foregoing decision, all cards required for the use of the different Bureaus, Offices, and Divisions of this Department in connection with card-index systems, with the exception of absolutely blank cards without printing, ruling, or perforation, will be obtained from the Government Printing Office exclusively, upon requisition.

WILLIS L. MOORE,  
*Acting Secretary.*

#### RECOMMENDATION REGARDING EXPENDITURES FOR INDEX CARDS.

Under the foregoing order the Secretary of Agriculture approved the following recommendation by the chief of this Division:

U. S. DEPARTMENT OF AGRICULTURE,  
DIVISION OF PUBLICATIONS,  
Washington, D. C., December 18, 1902.

DEAR SIR: Under General Order No. 57, dated August 1, 1902, officers and employees of the Department of Agriculture were instructed that all index cards requiring printing, binding, or perforation must be procured from the Government Printing Office upon requisition. The aggregate amount of such work is considerable, and if the cost be defrayed from the general printing fund, that fund would be reduced to an extent that will interfere with the regular publication work of the Department. It is recommended, therefore, that beginning with January 1, 1903, the expense of all index cards be charged to the funds of the Bureau, Division, or Office desiring them. To avoid multiplying authorizations a sufficient supply should be ordered to last until June 30, 1903. Heretofore these cards have been purchased for the various Bureaus and Divisions, and the cost charged either to their special funds or to the contingent fund of the Department, hence provision therefor was not made in the appropriation for the present year in the allotment for printing for the Department. Request for the cards should be made to this Division, as in the case of all other printing and binding.

Very respectfully,

GEO. WM. HILL,  
*Editor and Chief.*

Approved:

JAMES WILSON, *Secretary.*

#### MODIFICATION OF THE ORDER RELATING TO INDEX CARDS.

The order requiring that all index cards be procured from the Government Printing Office was modified February 11, 1903, in the following circular from the Office of the Secretary:

Circular.

U. S. DEPARTMENT OF AGRICULTURE,  
OFFICE OF THE SECRETARY,  
Washington, D. C., February 11, 1903.

To officers and employees of the Department of Agriculture, and others concerned:

You are informed that the Comptroller of the Treasury, in a decision dated December 30, 1902, has held that outright purchases by the Department of cards which are not specially printed for the Department, but which are for sale to the public generally, are not repugnant to the provisions of section 3786 of the Revised Statutes of the

United States as interpreted in the decision of the Comptroller of the Treasury dated July 18, 1902.

General Order No. 57, dated August 1, 1902, referring to this subject, is hereby modified accordingly.

JAMES WILSON, *Secretary.*

### STATISTICS OF PUBLICATION WORK.

The details of the publication work of the Department are given in the following tables:

#### *Number and classes of publications issued in the fiscal year 1903.*

##### Publications:

Chargeable to regular fund.....	503
Chargeable to divisional funds .....	24
Chargeable to Farmers' Bulletin fund.....	323
Printed as executive documents .....	7
Edited at Weather Bureau.....	81
Total.....	938

#### *Number of publications, original and reprint, and number of pages and copies of each class, fiscal years 1900, 1901, 1902, and 1903.*

Character of publication.	1900.			1901.		
	Number of publications.	Pages.	Copies.	Number of publications.	Pages.	Copies.
Original.....	225	10,852	4,338,978	262	14,656	3,903,094
Reprint.....	148	5,983	2,004,500	232	9,139	3,115,600
Weather Bureau.....	95	1,164	809,000	112	3,341	880,587
Total.....	468	17,999	7,152,478	606	27,136	7,899,281

Character of publication.	1902.			1903.		
	Number of publications.	Pages.	Copies.	Number of publications.	Pages.	Copies.
Original.....	355	18,184	4,009,136	375	21,262	4,583,225
Reprint.....	317	12,454	5,791,040	482	21,912	6,295,000
Weather Bureau.....	85	664	786,404	81	1,831	820,339
Total.....	757	31,302	10,586,580	938	45,005	11,698,564

#### *Number of publications issued from 1894 to 1903, by years.*

Year.	Number of publications.	Total number of copies.	Year.	Number of publications.	Total number of copies.
1894.....	205	3,169,310	1900.....	468	7,152,478
1895.....	254	4,100,660	1901.....	606	7,899,281
1896.....	376	6,561,700	1902.....	757	10,586,580
1897.....	424	6,541,210	1903.....	938	11,698,564
1898.....	501	6,280,365	Total.....	5,132	71,066,073
1899.....	603	7,075,975			



*Number of publications, original and reprint, and pages, by Bureaus, Divisions, and Offices, fiscal year 1903.*

Bureaus, Divisions, and Offices.	Publications.			Pages.			Number of copies.		
	Original.	Reprint.	Total.	Original.	Reprint.	Total.	Original.	Reprint.	Total.
Secretary's Office.....	8	7	15	422	273	695	133,000	42,600	175,600
Executive documents.....	7	.....	7	3,587	.....	3,587	589,600	.....	589,600
Accounts and Disbursements.....	1	.....	1	16	.....	16	200	.....	200
Animal Industry.....	23	71	94	926	2,368	3,294	158,100	1,176,500	1,334,600
Biological Survey.....	9	7	16	510	191	701	83,000	56,500	139,500
Chemistry.....	18	31	49	1,360	2,096	3,456	40,600	175,300	215,900
Entomology.....	31	48	79	841	2,602	3,443	218,350	513,400	731,750
Experiment Stations.....	123	132	255	7,488	6,927	14,415	329,200	1,926,200	2,255,400
Foreign Markets.....	5	7	12	592	876	1,468	27,500	7,500	35,000
Forestry.....	21	24	45	984	1,267	2,251	212,000	153,500	365,500
Library.....	7	.....	7	656	.....	656	6,075	.....	6,075
Plant Industry.....	47	85	132	1,491	3,273	4,764	397,700	1,244,000	1,641,700
Publications.....	20	20	40	851	700	1,551	1,090,000	390,000	1,480,000
Public Road Inquiries.....	8	38	46	344	1,076	1,420	60,500	358,000	418,500
Soils.....	26	7	33	656	166	852	30,100	175,000	205,100
Statistics.....	18	2	20	462	23	485	1,206,200	1,500	1,207,700
Weather Bureau.....	<sup>a</sup> 84	3	87	1,877	74	1,951	821,439	75,000	896,439
Total.....	456	482	938	23,093	21,912	45,005	5,403,564	6,295,000	11,698,564

<sup>a</sup> Edited at Weather Bureau, 81—pages, 1,831; copies, 820,339.

*Amount expended for the various Bureaus, Divisions, and Offices for printing and binding, 1903.*

Division of Accounts and Disbursements.....	\$2,484.07
Bureau of Animal Industry.....	9,988.53
Division of Biological Survey.....	3,895.27
Bureau of Chemistry.....	8,075.13
Division of Entomology.....	3,236.99
Office of Experiment Stations.....	22,980.99
Division of Foreign Markets.....	7,225.46
Bureau of Forestry.....	2,833.53
Library.....	6,078.32
Bureau of Plant Industry.....	25,098.18
Division of Publications.....	3,899.27
Office of Public Road Inquiries.....	7,076.44
Bureau of Soils.....	3,260.41
Division of Statistics.....	10,849.15
Miscellaneous.....	4,877.56
Printing at branch printing office for the various Bureaus, Divisions, and Offices.....	23,628.82

Total..... 145,488.12

*Farmers' Bulletins issued, 1899-1903, by years.*

Originals and reprints of Farmers' Bulletins.	Number of bulletins.	Number of copies.	Originals and reprints of Farmers' Bulletins.	Number of bulletins.	Number of copies.
Fiscal year 1903:			Fiscal year 1900:		
Originals.....	22	725,000	Originals.....	18	525,000
Reprints.....	301	5,877,000	Reprints.....	90	1,835,000
Total.....	323	6,602,000	Total.....	108	2,360,000
Fiscal year 1902:			Fiscal year 1899:		
Originals.....	23	575,000	Originals.....	22	520,000
Reprints.....	236	5,575,000	Reprints.....	154	1,917,000
Total.....	259	6,150,000	Total.....	176	2,437,000
Fiscal year 1901:					
Originals.....	14	415,000			
Reprints.....	157	2,930,000			
Total.....	171	3,345,000			

*Cost of printing Farmers' Bulletins, 1900-1903.*

Item.	Number of bulletins.	Number of copies.	Cost.
Fiscal year 1903: Paid from Farmers' Bulletin fund .....	323	6,602,000	\$95,534.18
Fiscal year 1902: Paid from Farmers' Bulletin fund .....	259	6,150,000	107,363.05
Fiscal year 1901: Paid from Farmers' Bulletin fund .....	171	3,345,000	51,796.68
Fiscal year 1900: Paid from Farmers' Bulletin fund .....	97	2,150,000	30,665.15
Paid from general printing fund .....	11	210,000	3,469.69
Total .....	108	2,360,000	34,134.84

*New Farmers' Bulletins issued during the fiscal year 1903.*

No. of bulletin.	Title of bulletin.	Total number of copies.
156	The Home Vineyard.....	30,000
157	The Propagation of Plants.....	40,000
158	How to Build Small Irrigation Ditches.....	30,000
159	Scab in Sheep.....	30,000
160	Game Laws for 1902.....	60,000
161	Practical Suggestions for Fruit Growers.....	30,000
162	Experiment Station Work—XXI.....	30,000
163	Methods of Controlling the Boll Weevil.....	100,000
164	Rape as a Forage Crop.....	30,000
165	Culture of the Silkworm.....	20,000
166	Cheese Making on the Farm.....	30,000
167	Cassava.....	15,000
168	Pearl Millet.....	20,000
169	Experiment Station Work—XXII.....	30,000
170	Principles of Horse Feeding.....	30,000
171	Control of the Codling Moth.....	30,000
172	Scale Insects and Mites on Citrus Fruits.....	20,000
173	A Primer of Forestry.....	30,000
174	Broom Corn.....	30,000
175	Home Manufacture and Use of Unfermented Grape Juice.....	30,000
176	Cranberry Culture.....	30,000
177	Squab Raising.....	30,000
	Total.....	725,000

*Farmers' Bulletins contributed by Bureaus, Divisions, and Offices, 1903.*

Bureaus, Divisions, and Offices.	New.	Reprints.	Number of copies.
Secretary's Office.....		3	32,000
Bureau of Animal Industry.....	3	63	1,238,000
Division of Biological Survey.....	1	4	115,000
Bureau of Chemistry.....		9	148,000
Division of Entomology.....	4	20	649,000
Office of Experiment Stations.....	4	92	1,998,000
Bureau of Forestry.....	1	3	71,000
Bureau of Plant Industry.....	9	66	1,471,000
Division of Publications.....		20	390,000
Office of Public Road Inquiries.....		11	240,000
Bureau of Soils.....		7	175,000
Weather Bureau.....		3	75,000
Total.....	22	301	6,602,000

*Number of copies of Farmers' Bulletins issued (Nos. 1 to 177) and number distributed to Members of Congress, 1894-1903.*

Date.	Total number of copies issued.	Congressional distribution.	Date.	Total number of copies issued.	Congressional distribution.
Prior to 1894 .....	540,000	.....	In 1900 .....	2,360,000	1,666,909
In 1894 .....	278,500	.....	In 1901 .....	3,345,000	2,195,010
In 1895 .....	1,567,000	885,770	In 1902 .....	6,150,000	4,289,126
In 1896 .....	1,891,000	1,316,695	In 1903 .....	6,602,000	3,954,976
In 1897 .....	2,387,000	1,967,237	Total .....	29,727,500	18,957,773
In 1898 .....	2,170,000	1,580,065			
In 1899 .....	2,437,000	1,101,985			

*New Farmers' Bulletins issued each year from 1895 to 1903, inclusive.*

Year.	Number of bulletins.	Year.	Number of bulletins.
In 1895 .....	11	In 1901 .....	14
In 1896 .....	13	In 1902 .....	23
In 1897 .....	16	In 1903 .....	22
In 1898 .....	21	Total .....	160
In 1899 .....	22		
In 1900 .....	18		

*Appropriations for the fiscal years 1902-1904.*

Appropriations.	1902.	1903.	1904.
Statutory roll .....	\$25,020	\$28,820	\$29,320
General printing fund .....	<i>a</i> 110,000	<i>a</i> 155,000	<i>b</i> 160,000
General printing fund, deficiency .....	20,000		
Preparation and printing of Farmers' Bulletins .....	107,500	107,500	105,000
Artists, laborers, and material fund .....	63,000		
Artists, laborers, and material fund, deficiency .....	15,000		
Rent of building and alterations .....	2,500		
Additional assistants, artists, draftsmen, etc .....		12,500	10,000
Labor, material, wagon, horses, rent of building, etc .....		<i>c</i> 84,000	85,000
Total .....	343,020	387,820	389,320

*a* Exclusive of \$20,000 for Weather Bureau.

*b* Exclusive of \$25,000 for Weather Bureau.

*c* Including a deficiency of \$4,000.

*Expenditures under general appropriations for fiscal year ended June 30, 1903.*

General printing fund .....	\$145,488.12
Preparation and printing of Farmers' Bulletins .....	95,534.18
Additional assistants, and material fund .....	11,810.95
Labor and material fund .....	83,715.89
Total .....	336,549.14

*Expenditures for printing and binding, total and by funds, 1903.*

#### TOTAL EXPENDITURES.

Divisional publications paid from general fund .....	\$101,094.49
Divisional publications paid from special funds .....	<i>a</i> 31,099.88
Blank books, blank forms, etc., paid from general fund .....	20,764.81
Blank books, blank forms, etc., paid from special funds .....	120.21
Branch office (all work) paid from general fund .....	23,628.82
Farmers' Bulletins paid from Farmers' Bulletin fund .....	88,993.79
Total .....	265,702.00

*a* Publications at an estimated cost of \$14,283.50 were not completed and bills not received.



## EXPENDITURES BY FUNDS.

General printing fund (\$155,000, exclusive of \$20,000 for Weather Bureau):	
Expended for the various Bureaus, Divisions, and Offices.....	\$121, 859. 30
Expended for printing at branch office for the various Bureaus, Divisions, and Offices.....	23, 628. 82
	<hr/>
	\$145, 488. 12
Farmers' Bulletin fund .....	88, 993. 79
Divisional funds:	
Bureau of Animal Industry .....	1. 29
Division of Biological Survey.....	1, 590. 82
Division of Entomology .....	4. 52
Office of Experiment Stations.....	9, 973. 36
Bureau of Forestry .....	19, 648. 11
Bureau of Plant Industry .....	1. 99
	<hr/>
	31, 220. 09
Total .....	<hr/>
	265, 702. 00

*Expenditures from the special funds of the Division.*

Expenditures from the special appropriation of this Division, \$12,500, for additional assistants, pay of artists and draftsmen, artists' supplies, etc.:	
Illustrating, including pay of artists.....	\$6, 249. 85
Artists' supplies .....	1, 889. 24
Pay of additional assistants, purchase of manuscripts, etc.....	3, 671. 61
	<hr/>
Total .....	11, 810. 70
	<hr/>
From fund, \$80,000, and deficiency appropriation, \$4,000, for labor and material in the distribution of documents, etc.:	
Labor in distribution of documents .....	72, 926. 06
Materials for document section .....	9, 389. 91
Rent for building for storage and distribution of Farmers' Bulletins.....	1, 399. 92
	<hr/>
Total .....	83, 715. 89
	<hr/>
From fund for preparation and printing of Farmers' Bulletins:	
Preparation of Farmers' Bulletins .....	6, 540. 39
Printing Farmers' Bulletins .....	88, 993. 79
	<hr/>
Total .....	95, 534. 18
	<hr/>
Grand total .....	191, 060. 77

*Requisitions on the main office by Bureaus, Divisions, Offices, etc., 1903.*

Secretary's Office.....	8
Division of Accounts and Disbursements .....	72
Bureau of Animal Industry .....	131
Division of Biological Survey .....	32
Bureau of Chemistry .....	63
Division of Entomology.....	68
Office of Experiment Stations .....	242
Division of Foreign Markets.....	14
Bureau of Forestry .....	83
Library.....	35
Bureau of Plant Industry .....	229
Division of Publications.....	47
Office of Public Road Inquiries.....	39
Bureau of Soils.....	68
Division of Statistics .....	39
Weather Bureau .....	5
Miscellaneous .....	28
	<hr/>
Total .....	1, 203

*Publications printed in the branch printing office, 1903.*

Bureaus, Divisions, and Offices.	Requisitions.	Number of of copies printed.
Bureau of Animal Industry.....	5	23,500
Bureau of Chemistry.....	1	200
Division of Entomology.....	13	42,000
Office of Experiment Stations.....	7	4,500
Division of Foreign Markets.....	1	9,000
Bureau of Forestry.....	3	3,000
Division of Publications.....	14	935,000
Division of Statistics.....	3	1,500
Total.....	47	1,018,700

*Total work done in the branch printing office, 1903.*

Envelopes.....	1,972,184
Letter heads and note heads.....	1,357,412
Cards.....	2,889,230
Circulars.....	255,948
Blanks.....	4,312,705
Labels and shipping tags.....	733,603
Franks.....	1,628,345
Monthly and other lists.....	1,046,209
Crop Reporter.....	<sup>a</sup> 1,500
Circular letters and other notices.....	760,190
Miscellaneous.....	1,694,333
Total.....	16,651,659

Number of requisitions, 1903.....	3,356
Number of requisitions, 1902.....	2,500
Number of pieces of work, 1902 <sup>b</sup> .....	22,715,904

*Requisitions on the branch printing office by Bureaus, Divisions, Offices, etc., 1903.*

Secretary's Office.....	8
Division of Accounts and Disbursements.....	73
Bureau of Animal Industry.....	338
Division of Biological Survey.....	78
Bureau of Chemistry.....	167
Division of Entomology.....	76
Office of Experiment Stations.....	265
Division of Foreign Markets.....	29
Bureau of Forestry.....	167
Library.....	49
Bureau of Plant Industry.....	1,148
Division of Publications.....	177
Office of Public Road Inquiries.....	42
Bureau of Soils.....	89
Division of Statistics.....	379
Miscellaneous.....	271
Total.....	3,356

<sup>a</sup> Composition for 12 editions of Crop Reporter, 8 pages each, was done in the branch office.

<sup>b</sup> Although the number of pieces was less than in 1902, the amount of work was much greater, as is shown by the large increase in the number of requisitions issued. Franks to the number of 9,889,450 were printed in 1902, against 1,628,345 in 1903.

*Illustration work, 1903.*

Drawings, retouching photographs, photographing on wood, etc., made by the artists in the Division of Publications.....	1,790
Wood engravings.....	31
Requests for duplicate electrotypes.....	231
Duplicate electrotypes furnished to correspondents on request.....	2,286
Requisitions and authorizations.....	135
Illustrations printed or published (not including reprints).....	2,593
Negatives made.....	148
Silver prints for pen drawings.....	109
Velox and albuma prints.....	280

*Number and cost of illustrations by Bureaus, Divisions, and Offices, 1903.*

Bureaus, Divisions, and Offices.	Illustrations.	Cost of illustrations.	Amount chargeable to divisional funds.	Amount chargeable to additional assistants fund.
Bureau of Animal Industry.....	26	\$572.23	\$564.30	\$7.93
Division of Biological Survey.....	5	4.89	.....	4.89
Bureau of Chemistry.....	29	27.65	.....	27.65
Division of Entomology.....	117	113.62	9.50	104.12
Office of Experiment Stations.....	93	195.76	176.92	18.84
Bureau of Forestry.....	35	62.90	4.00	58.90
Bureau of Plant Industry.....	102	372.43	10.46	361.97
Division of Publications.....	80	442.55	.....	442.55
Office of Public Road Inquiries.....	10	33.07	.....	33.07
Bureau of Soils.....	8	65.73	15.00	50.73
Total.....	505	1,890.83	780.18	1,110.65
Artists' supplies.....	.....	1,889.24	.....	1,889.24
Artists' salaries.....	.....	5,139.20	.....	5,139.20
Total.....	505	8,919.27	780.18	8,139.09

*Number of publications sold by the Superintendent of Documents and amount received, 1899-1903.*

Department.	Copies of publications sold.					Amount received.				
	1903.	1902.	1901.	1900.	1899.	1903.	1902.	1901.	1900.	1899.
Department of Agriculture.....	30,038	25,279	24,127	16,905	18,750	\$4,200.35	\$3,551.91	\$3,220.25	\$2,157.65	\$2,154.45
All other Departments.....	11,048	9,932	9,458	10,998	8,058	7,435.69	7,394.30	6,862.44	6,744.56	5,401.66
Total.....	41,086	35,211	33,585	27,903	26,808	11,636.04	10,946.21	10,082.69	8,902.21	7,556.11



## APPENDIX A.

## PUBLICATIONS ISSUED DURING THE YEAR ENDED JUNE 30, 1903.

[The following publications were issued during the year ended June 30, 1903. Those to which a price is attached, with the exception of publications of the Weather Bureau, must be obtained of the Superintendent of Documents, Union Building, Washington, D. C., to whom are turned over all copies not needed for official use, in compliance with section 67 of the act providing for the public printing and binding and the distribution of public documents. Remittances should be made to him by postal money order. Weather Bureau publications to which a price is attached must be obtained from the chief of that Bureau. Applications for those that are for free distribution should be made to the Secretary of Agriculture, Washington, D. C.]

## OFFICE OF THE SECRETARY.

	Copies.
Progress of the Beet-Sugar Industry in the United States. By Charles F. Saylor, Special Agent and Investigator. Pp. ii, 487-502, pls. 4. (Reprint from Yearbook of Department of Agriculture for 1901.) July 14, 1902..	500
Progress of the Beet-Sugar Industry in the United States in 1901. By Charles F. Saylor, Special Agent. With contributions from the Bureau of Plant Industry, prepared under the direction of B. T. Galloway, Chief. Pp. 106, pls. 15, figs. 5. Report No. 72. August 30, 1902. Price, 15 cents.	5,000
Sewage Disposal on the Farm, and the Protection of Drinking Water. By Theobald Smith, M. D., Professor in Harvard University, Pathologist to the Massachusetts State Board of Health, etc. Pp. 20, figs. 8. Farmers' Bulletin No. 43. (Reprint.) August 25, 1902 .....	30,000*
Report of the Secretary of Agriculture, 1902. Pp. 122. November 29, 1902.	5,000
Report No. 73. Report of the Secretary of Agriculture, 1902. Pp. 96. December 18, 1902 .....	40,000
Report of the Appointment Clerk for 1902. By J. B. Bennett. Pp. ii, 383-400. (Reprint from Annual Reports, Department of Agriculture.) January 9, 1903 .....	2,000
Tobacco: Instructions for its Cultivation and Curing. By John M. Estes, Special Agent. Pp. 8. Farmers' Bulletin No. 6. (Reprint.) April 24, 1903 .....	1,000
Washed Soils: How to Prevent and Reclaim Them. Pp. 22, figs. 6. Farmers' Bulletin No. 20. (Reprint.) April 27, 1903 .....	1,000
Sugar-Beet Pulp as Animal Food. By Charles F. Saylor, Special Agent. Pp. 35. (Reprint from Report on Progress of Beet-Sugar Industry, 1902.) April 27, 1903 .....	40,000
Reprint, June 23, 1903 .....	5,000
Single-Germ Beet Balls and Other Suggestions for Improving Sugar-Beet Culture. By Truman G. Palmer. Pp. 11. (Reprint from Report on Progress of Beet-Sugar Industry in 1902.) May 5, 1903 .....	40,000
Reprint, June 24, 1903 .....	5,000
Sheep and Wool: A Review of the Progress of American Sheep Husbandry. By J. R. Dodge, Special Agent. Pp. 63, figs. 3. Report No. 66. (Reprint.) May 7, 1903 .....	300
Report of the Secretary of Agriculture. 1901. Pp. 113. (Reprint.) May 8, 1903 .....	300
Selecting and Judging Horses for Market and Breeding Purposes. By W. J. Kennedy, Vice-Director of Iowa Experiment Station and Professor of Animal Husbandry, Iowa Agricultural College. Pp. ii, 455-468, fig. 1. (Reprint from Yearbook of Department of Agriculture for 1902.) June 22, 1903 .....	500

## CONGRESSIONAL.

A Message from the President of the United States, transmitting a Report of the Secretary of Agriculture in Relation to the Forests, Rivers, and Mountains of the Southern Appalachian Region. Pp. 210, pls. 78. (Senate Doc. No. 84, 57th Cong., 1st sess.) September, 1902. Price, cloth, \$1.20; paper, \$1.10 .....	10,000
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	Copies.
Field Operations of the Bureau of Soils, 1901 [Third Report]. By Milton Whitney, Chief. With Accompanying Papers by Assistants in Charge of Field Parties. Pp. 647, pls. 96, figs. 25, maps 31, in case. Cloth. November 26, 1902. Price, \$2.25.....	17, 000
Eighteenth Annual Report of the Bureau of Animal Industry for the Year 1901. Pp. 706, pls. 117, figs. 224. December 18, 1902. Price, cloth, 90 cents; paper, 75 cents.....	30, 000
Annual Reports of the Department of Agriculture for the Fiscal Year ended June 30, 1902. Pp. cxxiv, 1-402. January 7, 1903.....	3, 000
Message from the President of the United States, Transmitting a Report by the Secretary of Agriculture of the Operations of the Bureau of Animal Industry of that Department for the Fiscal Year ending June 30, 1902. Pp. 89. (Senate Doc. No. 105, 57th Cong., 2d sess.) February 28, 1903..	1, 800
Yearbook of the U. S. Department of Agriculture, 1902. Pp. 912, pls. 87, figs. 62. May 29, 1903. Price, 85 cents.....	500, 000
Annual Report of the Office of Experiment Stations for the year ended June 30, 1902. Pp. 547, pls. 48, figs. 2.....	1, 800

## DIVISION OF ACCOUNTS AND DISBURSEMENTS.

Report of the Chief of the Division of Accounts and Disbursements for 1902. By F. L. Evans. Pp. iii, 219-233. (Reprint from Annual Reports, Department of Agriculture.) December 31, 1902.....	200
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## BUREAU OF ANIMAL INDUSTRY.

Raising Sheep for Mutton. By Charles F. Curtiss, Director of the Iowa Agricultural Experiment Station. Pp. 48, figs. 18. Farmers' Bulletin No. 96. (Reprint.) July 21, 1902.....	15, 000
Reprint, October 1, 1902.....	30, 000
Reprint, May 2, 1903.....	10, 000
Hog Cholera and Swine Plague. By D. E. Salmon, D. V. M., Chief of the Bureau of Animal Industry. Pp. 16. Farmers' Bulletin No. 24. (Reprint.) August 1, 1902.....	15, 000
Reprint, August 2, 1902.....	10, 000
Reprint, August 5, 1902.....	30, 000
Reprint, March 16, 1903.....	20, 000
Reprint, May 13, 1903.....	10, 000
Breeds of Dairy Cattle. By Henry E. Alvord, C. E., Chief of Dairy Division, Bureau of Animal Industry. Pp. 48, figs. 21. Farmers' Bulletin No. 106. (Reprint.) August 1, 1902.....	20, 000
Reprint, August 16, 1902.....	30, 000
Reprint, December 29, 1902.....	20, 000
Reprint, March 17, 1903.....	20, 000
Reprint, May 12, 1903.....	15, 000
Reprint, June 24, 1903.....	20, 000
Butter Making on the Farm. By C. P. Goodrich, Dairy Instructor, Farmers' Institute Department, University of Wisconsin. Under supervision of the Dairy Division, Bureau of Animal Industry. Pp. 16. Farmers' Bulletin No. 57. (Reprint.) August 7, 1902.....	30, 000
Reprint, January 23, 1903.....	10, 000
Reprint, March 12, 1903.....	10, 000
Reprint, May 12, 1903.....	10, 000
Reprint, May 25, 1903.....	10, 000
The Dairy Herd: Its Formation and Management. By Henry E. Alvord, C. E., Chief of Dairy Division, Bureau of Animal Industry. (Reprinted, with revision by the author, from the Yearbook of the U. S. Department of Agriculture for 1894.) Pp. 24. Farmers' Bulletin No. 55. (Reprint.) August 11, 1902.....	10, 000
Reprint, August 12, 1902.....	30, 000
Reprint, December 20, 1902.....	20, 000
Reprint, May 11, 1903.....	10, 000
Reprint, June 1, 1903.....	10, 000
Care of Milk on the Farm. By R. A. Pearson, B. S., Assistant Chief of Dairy Division, Bureau of Animal Industry. Pp. 40, figs. 9. Farmers' Bulletin No. 63. (Reprint.) August 12, 1902.....	15, 000
Reprint, September 20, 1902.....	30, 000

	Copies.
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	Copies.
Historical and Technical Papers on Road Building in the United States. Compiled under direction of Roy Stone, Special Agent and Engineer. Pp. 52, figs. 7. Bulletin No. 7. (Reprint.) January 12, 1903. Price, 5 cents .....	3, 000
Earth Roads: Hints on Their Construction and Repair. Compiled by Roy Stone, Special Agent in Charge of Road Inquiry. Pp. 20, figs. 11. Bulletin No. 8. (Reprint.) January 14, 1903. Price, 5 cents .....	3, 000
Proceedings of the International Good Roads Congress, Held at Buffalo, N. Y., September 16 to 21, 1901. Pp. 100. Bulletin No. 21. (Reprint.) January 22, 1903. Price, 5 cents .....	5, 000
Proceedings of the Jefferson Memorial and Interstate Good Roads Convention, Held at Charlottesville, Va., April 2, 3, and 4, 1902. Pp. 60, pls. 5, figs. 2. Bulletin No. 25. March 16, 1903. Price, 10 cents .....	10, 000
Reprint, May 8, 1903 .....	5, 000
Cost of Hauling Farm Products to Market or to Shipping Points in European Countries. Pp. 12. Circular No. 27, Office of Road Inquiry. March 23, 1903 .....	10, 000
Office of Road Inquiry. By Roy Stone, Director of Office of Road Inquiry.—Object-Lesson Roads. By Roy Stone, Director of Office of Road Inquiry. Pp. 175-180, 373-382, pls. 2, fig. 1. (Reprint from Yearbook of Department of Agriculture for 1901.) (Reprint.) March 31, 1903 .....	5, 000
Wide Tires. Laws of Certain States Relating to Their Use, and Other Pertinent Information. Compiled by Roy Stone, Special Agent in Charge of Road Inquiry. Pp. 16. Bulletin No. 12. Office of Road Inquiry. (Reprint.) April 23, 1903. Price, 5 cents .....	5, 000
Road Improvement in New York. Pp. 15. Circular No. 35. (Reprint.) June 10, 1903 .....	5, 000
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Use of Mineral Oil in Road Improvement. By James W. Abbott, Special Agent, Rocky Mountain and Pacific Coast Division, Office of Public Road Inquiries. Pp. iii, 439-454, pls. 3, figs. 4. (Reprint from Yearbook of Department of Agriculture for 1902.) June 15, 1903 .....	10, 000
State Aid to Road Building in Minnesota. By A. B. Choate. Pp. 12, figs. 5. Circular No. 32. (Reprint.) June 18, 1903 .....	5, 000
BUREAU OF SOILS.	
The Culture of Tobacco. By Otto Carl Butterweck. Pp. 24. Farmers' Bulletin No. 82. (Reprint.) September 9, 1902 .....	15, 000
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Tobacco Soils. By Milton Whitney, Chief of Division of Soils. Pp. 23, fig. 1. Farmers' Bulletin No. 83. (Reprint.) September 27, 1902 .....	30, 000
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Methods of Curing Tobacco. By Milton Whitney, Chief of Division of Soils. Pp. 24. Farmers' Bulletin No. 60, second revised edition. (Reprint.) October 24, 1902 .....	30, 000
Report of the Chief of the Bureau of Soils for 1902. By Milton Whitney. Pp. iv, 155-188. (Reprint from Annual Reports, Department of Agriculture.) December 30, 1902 .....	100
Reprints from Report on Field Operations of the Bureau of Soils for 1901:	
Soil Survey of Harford County, Maryland. By W. G. Smith and J. O. Martin. Pp. iii, 211-237, map. January 22, 1903 .....	1, 000
Soil Survey of the San Gabriel Area, California. By J. Garnett Holmes and Louis Mesmer. Pp. iii, 559-586, pls. 2, figs. 2, map 1. February 7, 1903 .....	1, 000
Soil Survey Around Imperial, California. By Thomas H. Means and J. Garnett Holmes. Pp. iii, 587-606. February 10, 1903 .....	1, 000
Soil Survey of the Prince Edward Area, Virginia. By Charles N. Mooney and Thomas A. Caine. Pp. iii, 259-271, map. February 10, 1903 .....	1, 000



Reprints from Report on Field Operations of the Bureau of Soils for 1901—  
Continued.

Soil Survey of the Willis Area, Texas. By J. O. Martin. Pp. iii, 607-619, pl. 1, fig. 1. February 11, 1903.....	1, 000
Soil Survey of the Ventura Area, California. By J. Garnett Holmes and Louis Mesmer. Pp. iii, 521-557, pls. 7, maps 2. February 12, 1903...	1, 000
Soil Survey of the Lake Charles Area, Louisiana. By W. H. Heileman and Louis Mesmer. Pp. iii, 621-647, fig. 1, map 1. February 12, 1903.	1, 000
Soil Survey of the Statesville Area, North Carolina. By Clarence W. Dorsey and party. Pp. iii, 273-295, fig. 1, map 1. February 13, 1903.	1, 000
Soil Survey of the Westfield Area, New York. By R. T. Avon Burke and Herbert W. Marean. Pp. iii, 75-92, pls. 5, figs. 2, map 1. February 16, 1903.....	1, 000
Soil Survey of the Bedford Area, Virginia. By Charles N. Mooney, F. O. Martin, and Thomas A. Caine. Pp. iii, 239-257, pls. 6, fig. 1, map 1. February 16, 1903.....	1, 000
Soil Survey of the Salem Area, New Jersey. By Jay A. Bonsteel and F. W. Taylor. Pp. iii, 125-148, fig. 1, map 1. February 17, 1903...	1, 000
Soil Survey of the Lebanon Area, Pennsylvania. By W. G. Smith and Frank Bennett, jr. Pp. iii, 149-171, pls. 4, fig. 1, map 1. February 18, 1903.....	1, 000
Soil Survey of Covington Area, Georgia. By Herbert W. Marean. Pp. iii, 329-340, pls. 3, map 1. February 19, 1903.....	1, 000
Soil Survey of Prince George County, Maryland. By Jay A. Bonsteel and party. Pp. iii, 173-210, pls. 5, fig. 1, map 1. February 21, 1903.	1, 000
Soil Survey of Montgomery County, Tennessee. By J. E. Lapham and M. F. Miller. Pp. iii, 341-357, pls. 5, fig. 1, map 1. February 21, 1903.....	1, 000
Soil Survey of the Yazoo Area, Mississippi. By Jay A. Bonsteel and party. Pp. iii, 359-388, pls. 9, figs. 2, map 1. February 21, 1903....	1, 000
Soil Survey of the Boise Area, Idaho. By Charles A. Jensen and B. A. Olshausen. Pp. iii, 421-446, pls. 5, figs. 3, maps 4. February 21, 1903.	1, 000
Soil Survey of Alamance, North Carolina. By George N. Coffey and W. Edward Hearn. Pp. iii, 297-310, pls. 3, map 1. February 26, 1903.....	1, 000
Soil Survey of Cobb County, Georgia. By R. T. Avon Burke and Herbert W. Marean. Pp. iii, 317-327, fig. 1, map. February 26, 1903 ..	1, 000
Soil Survey of Allegan County, Michigan. By Elmer O. Fippin and Thomas D. Rice. Pp. iii, 93-124, pls. 10, fig. 1, map 1. February 27, 1903.....	1, 000
Soil Survey of the Hanford Area, California. By Macy H. Lapham and W. H. Heileman. Pp. iii, 447-480, pls. 4, figs. 2, maps 2. April 9, 1903.....	1, 000
Soil Survey of the Lower Salinas Valley, California. By Macy H. Lapham and W. H. Heileman. Pp. iii, 481-519, pls. 5, maps 2. April 9, 1903.....	1, 000
Soil Survey of the Yakima Area, Washington. By Charles A. Jensen and B. A. Olshausen. Pp. iv, 389-419, pls. 11, figs. 4, maps 2. April 10, 1903.....	1, 000
Reclamation of Alkali Lands in Egypt, as Adapted to Similar Work in the United States. By Thos. H. Means, in Charge of Alkali Land Reclamation, Bureau of Soils. In Cooperation with the Office of Seed and Plant Introduction and Distribution, Bureau of Plant Industry. Pp. 48, pls. 8, figs. 6. Bulletin No. 21. June 12, 1903. Price, 15 cents.....	5, 000
Crops Used in the Reclamation of Alkali Lands in Egypt. By Thomas H. Kearney, of the Bureau of Plant Industry, and Thomas H. Means, of the Bureau of Soils. Pp. iii, 573-588, pls. 4, figs. 2. (Reprint from Yearbook of Department of Agriculture for 1902.) June 15, 1903.....	2, 000

## DIVISION OF STATISTICS.

Crop Reporter. Vol. 4, No. 3. Pp. 8. July, 1902.....	95, 000
Crop Reporter. Vol. 4, No. 4. Pp. 8. August, 1902.....	95, 000
Crop Reporter. Vol. 4, No. 5. Pp. 8. September, 1902.....	95, 000
Crop Reporter. Vol. 4, No. 6. Pp. 8. October, 1902.....	95, 000
Crop Reporter. Vol. 4, No. 7. Pp. 8. November, 1902.....	100, 000
Crop Reporter. Vol. 4, No. 8. Pp. 8. December, 1902.....	95, 000
Crop Reporter. Vol. 4, No. 9. Pp. 8. January, 1903.....	100, 000

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Crop Reporter. Vol. 4, No. 11. Pp. 8. March, 1903.....	98,000
Crop Reporter. Vol. 4, No. 12. Pp. 8. April, 1903.....	98,500
Crop Reporter. Vol. 5, No. 1. Pp. 1-8. May, 1903.....	100,000
Crop Reporter. Vol. 1, No. 6. Pp. 4. October, 1899. (Reprint).....	500
Crop Reporter. Vol. 5, No. 2. Pp. 9-19. June, 1903.....	100,000
Wheat Ports of the Pacific Coast. By Edwin S. Holmes, Jr., Field Agent, Division of Statistics. Pp. ii, 567-580, pls. 5. (Reprint from Yearbook of Department of Agriculture for 1901.) July 19, 1902.....	2,000
Keeping Goats for Profit. By Almont Barnes, of the Division of Statistics. Pp. ii, 421-438. (Reprint from Yearbook of Department of Agriculture for 1898.) (Reprint.) August 16, 1902.....	1,000
Statistical Matter Relating to Principal Crops and Farm Animals, Freight Rates, Exports, etc., in the United States, 1901. Pp. 697-810. (Reprint from Yearbook of Department of Agriculture for 1901.) August 16, 1902.....	10,000
Relations of Population and Food Products in the United States, Exclusive of Alaska and the Insular Possessions; Mainly as Indicated by Census Reports, 1850-1900. By James H. Blodgett, A. M., Division of Statistics. Pp. 86. Bulletin No. 24. April 8, 1903. Price, 5 cents.....	8,000
Statistical Matter Relating to Principal Crops and Farm Animals, Freight Rates, Exports, etc., of the United States, 1902. Pp. 760-876. (Reprint from Yearbook of Department of Agriculture for 1902.) June 13, 1903 ..	10,000
Flaxseed Production, Commerce, and Manufacture in the United States. By Charles M. Daugherty, of the Division of Statistics. Pp. iii, 421-438. (Reprint from Yearbook of Department of Agriculture for 1902.) June 22, 1903.....	1,200
Practices in Crop Rotation. By George K. Holmes, of the Division of Statistics. Pp. ii, 519-532. (Reprint from Yearbook of Department of Agriculture for 1902.) June 23, 1903.....	3,500

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Monthly Weather Review (a summary by months of weather conditions throughout the United States, based upon reports of nearly 3,000 regular and voluntary observers.) Quarto. Price, 20 cents each; \$2 per year.

Vol. XXX, No. 4. April, 1902. Pp. 157-243, charts 8, map, figs. 4...	4,600
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Vol. XXXI, No. 3. March, 1903. Pp. 109-164, charts 10, figs. 13....	4,800
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Notes on Frost. By E. B. Garriott, Professor of Meteorology, Weather Bureau. Pp. 24. Farmers' Bulletin No. 104. (Reprint.) September 4, 1902.....	15,000
Reprint. September 11, 1902.....	30,000
Protection of Food Products from Injurious Temperatures. By H. E. Williams, Chief Clerk Weather Bureau. Pp. 26. Farmers' Bulletin No. 125. (Reprint.) September 26, 1902.....	30,000
Proceedings of the Second Convention of Weather Bureau Officials, Held at Milwaukee, Wis., August 27, 28, 29, 1901. Edited under the direction of Willis L. Moore, Chief U. S. Weather Bureau. By James Berry, Secretary of the Convention, and W. R. F. Phillips. Pp. 246, pls. 38, figs. 3. Bulletin No. 31. September, 1902.....	5,000
Studies on the Statics and Kinematics of the Atmosphere in the United States. Reprints from the Monthly Review, January to July, 1902. By Frank H. Bigelow, M. A., L. H. D., Professor of Meteorology. Prepared under the direction of Willis L. Moore, Chief U. S. Weather Bureau. Pp. iv, 1-62, figs. 29. November 24, 1902.....	500

	Copies.
Report of the Chief of the Weather Bureau, 1901-2. By Willis L. Moore. Part I, Administrative. Parts II, III, IV, and V, Climatology. Part VI, Miscellaneous meteorological tables and reports. Pp. xxvii, 1-342, charts 5. Quarto. Cloth. January 14, 1903 .....	1, 000
Instructions for Obtaining and Tabulating Records from Recording Instruments. Circular A, Instrument Division, second edition. By C. V. Marvin. Prepared under the direction of Willis L. Moore, Chief U. S. Weather Bureau. Pp. 31, figs. 2. (W. B. No. 277.) January 20, 1903...	1, 500
Serial Numbers for Weather Bureau Publications. Pp. 7. (Reprint from Monthly Weather Review for November, 1902.) February 26, 1903.....	500
Meteorological Chart of the Great Lakes. Summary for the season of 1902. No. 2, 1902. By Alfred J. Henry and Norman B. Conger. Prepared under the direction of Willis L. Moore, Chief U. S. Weather Bureau. Pp. 17, charts 4. (W. B. No. 280.) March 10, 1903. Price, 10 cents....	2, 500
Report of the Chief of the Weather Bureau. By Willis L. Moore. Pp. xxv, 1-342, charts 5. In six parts. April 14, 1903 .....	4, 000
Wet and Dry Seasons in California. By Alexander G. McAdie, Professor of Meteorology, United States Weather Bureau, San Francisco, Cal. Pp. ii, 187-204, pl. 1, figs. 7. (Reprint from Yearbook of Department of Agriculture for 1902.) June 4, 1903 .....	100
Climate of the Forest-Denuded Portion of the Upper Lake Region. By Willis L. Moore, Chief of Weather Bureau. Pp. iv, 125-132. (Reprint from Yearbook of Department of Agriculture for 1902.) June 6, 1903....	500
Meteorological Chart of the Great Lakes. No. 1, 1903. By Alfred J. Henry and Norman B. Conger. Prepared under direction of Willis L. Moore, Chief U. S. Weather Bureau. Pp. 23. (W. B. No. 286.) June 10, 1903. Price, 10 cents .....	2, 500
Rainfall and Irrigation. By Edward A. Beals, Forecast Official, Weather Bureau. Pp. iii, 627-642, figs. 6. (Reprint from Yearbook of Department of Agriculture for 1902.) June 11, 1903 .....	500
Climate and Crop Bulletin No. 16. July 7, 1902 .....	4, 500
Climate and Crop Bulletin No. 17. July 14, 1902 .....	4, 500
Climate and Crop Bulletin No. 18. July 21, 1902 .....	4, 500
Climate and Crop Bulletin No. 19. July 28, 1902 .....	4, 500
Climate and Crop Bulletin No. 20. August 4, 1902 .....	4, 500
Climate and Crop Bulletin No. 21. August 11, 1902 .....	4, 500
Climate and Crop Bulletin No. 22. August 18, 1902 .....	4, 500
Climate and Crop Bulletin No. 23. August 25, 1902 .....	4, 500
Climate and Crop Bulletin No. 24. September 1, 1902 .....	4, 575
Climate and Crop Bulletin No. 25. September 8, 1902 .....	4, 600
Climate and Crop Bulletin No. 26. September 15, 1902 .....	4, 654
Climate and Crop Bulletin No. 27. September 22, 1902 .....	4, 575
Climate and Crop Bulletin No. 28. September 29, 1902 .....	4, 600
Climate and Crop Bulletin No. 29. October, 1902 .....	4, 950
Climate and Crop Bulletin No. 30. November, 1902 .....	4, 900
Climate and Crop Bulletin No. 31. December, 1902 .....	4, 500
Climate and Crop Bulletin No. 1. January, 1903 .....	4, 935
Climate and Crop Bulletin No. 2. February, 1903 .....	4, 950
Climate and Crop Bulletin No. 3. March, 1903 .....	4, 900
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Climate and Crop Bulletin No. 5. April 20, 1903 .....	4, 500
Climate and Crop Bulletin No. 6. April 27, 1903 .....	4, 500
Climate and Crop Bulletin No. 7. May 4, 1903 .....	4, 800
Climate and Crop Bulletin No. 8. May 11, 1903 .....	4, 540
Climate and Crop Bulletin No. 9. May 18, 1903 .....	4, 525
Climate and Crop Bulletin No. 10. May 25, 1903 .....	4, 525
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Climate and Crop Bulletin No. 14. June 22, 1903 .....	5, 550
Climate and Crop Bulletin No. 15. June 29, 1903 .....	5, 550
Snow and Ice Bulletin. December 2, 1902 .....	1, 880
Snow and Ice Bulletin. December 9, 1902 .....	1, 850
Snow and Ice Bulletin. December 16, 1902 .....	1, 900
Snow and Ice Bulletin. December 23, 1902 .....	1, 900
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Snow and Ice Bulletin. February 17, 1903.....	1, 900
Snow and Ice Bulletin. February 24, 1903.....	1, 900
Snow and Ice Bulletin. March 3, 1903.....	1, 800
Snow and Ice Bulletin. March 10, 1903.....	1, 800
Snow and Ice Bulletin. March 17, 1903.....	1, 800
Daily Weather Map (showing weather conditions throughout the United States and giving forecasts of probable changes):	
July, 1902.....	46, 011
August, 1902.....	46, 000
September, 1902.....	46, 024
October, 1902.....	45, 970
November, 1902.....	45, 980
December, 1902.....	45, 985
January, 1903.....	46, 427
February, 1903.....	46, 420
March, 1903.....	46, 433
April, 1903.....	47, 525
May, 1903.....	47, 560
June, 1903.....	47. 595

## APPENDIX B.

REPORT IN DETAIL OF PUBLICATIONS OF THE U. S. DEPARTMENT OF AGRICULTURE RECEIVED AND DISTRIBUTED DURING THE FISCAL YEAR ENDED JUNE 30, 1903, THE PUBLICATION OF WHICH IS PROVIDED FOR BY LAW.

[NOTE.—The publications of the Weather Bureau are not distributed from the Division of Publications, but by an official in that Bureau specially charged with such work, and directed by the order of the Secretary of Agriculture, dated March 29, 1897, to report to the chief of this Division. A list of Weather Bureau publications is given in separate tables.]

*Publications other than Farmers' Bulletins received and distributed from July 1, 1901, to June 30, 1903.*

Publication.	Received.	Distributed.
Publications on hand July 1, 1902.....	730,258	α 413,600
DIVISION OF ACCOUNTS AND DISBURSEMENTS.		
Report of Chief of Division of Accounts and Disbursements.....	200	200
OFFICE OF APPOINTMENT CLERK.		
Report of Appointment Clerk.....	2,000	800
BUREAU OF ANIMAL INDUSTRY.		
Bulletin No. 21 (reprint).....	3,000	7,252
Bulletin No. 39, Part II.....	2,000	1,479
Bulletin No. 39, Part III.....	2,000	1,565
Bulletin No. 41 (reprint).....	500	166
Bulletin No. 43.....	1,000	1,000
Bulletin No. 44.....	5,000	3,740
Circular No. 23 (reprint).....	20,000	16,891
Circular No. 35.....	500	469
Circular No. 38.....	20,000	18,537
Circular No. 39.....	8,000	3,502
Circular No. 40.....	5,000	3,525
Eighteenth Annual Report Bureau of Animal Industry.....	9,000	6,209
Reprints from Eighteenth Annual Report Bureau of Animal Industry:		
The Dairy Industry and Dairy Markets in Porto Rico.....	7,000	6,383
The Angora Goat Industry.....	8,800	7,900
Further Investigations on Verminous Diseases of Cattle, Sheep, and Goats in Texas.....	1,000	350
Frogs, Toads, and Carps as Eradicators of Fluke Diseases.....	1,000	320
The Significance of the Recent American Cases of Hookworm Disease.....	5,000	1,400
A Variety of Hog Cholera Bacillus, etc.....	300	300
Cattle Markets and Abattoirs in Europe.....	200	108
Virulence of the Bovine Tuberculosis for Monkeys, etc.....	300	300
Report of the Chief of the Bureau of Animal Industry, 1902.....	1,200	300
DIVISION OF BIOLOGICAL SURVEY.		
Bulletin No. 12 (revised edition).....	1,500	800
Bulletin No. 17.....	1,000	1,000
Circular No. 36 (reprint).....	500	500
Circular No. 37 (reprint).....	500	300
Circular No. 38.....	10,000	6,400
Report of Chief of Biological Survey.....	500	340
North American Fauna No. 22.....	3,000	2,700
DIVISION OF BOTANY.		
Bulletin No. 16 (reprint).....	5,000	7,813
Circular No. 30 (reprint).....	2,000	889
Circular No. 15 (reprint).....	3,000	936
Contributions U. S. National Herbarium, Vol. V, No. 4.....	1,000	765
Contributions U. S. National Herbarium, Vol. V, No. 6.....	1,000	850
Contributions U. S. National Herbarium, Vol. VII, No. 1.....	1,000	910
Contributions U. S. National Herbarium, Vol. VII, No. 3.....	1,000	915

α Miscellaneous publications printed prior to July 1, 1902.

*Publications other than Farmers' Bulletins received and distributed from July 1, 1901, to June 30, 1903—Continued.*

Publication.	Received.	Distrib- uted.
BUREAU OF CHEMISTRY.		
Bulletin 13, Part IX (reprint).....	1,000	460
Bulletin 13, Part X.....	1,000	653
Bulletin 46 (reprint).....	500	500
Bulletin 50 (reprint).....	500	125
Bulletin No. 51 (reprint).....	150	28
Bulletin No. 52 (revised).....	250	170
Bulletin No. 57 (reprint).....	250	125
Bulletin No. 58 (reprint).....	500	200
Bulletin No. 59 (reprint).....	500	114
Bulletin No. 60 (reprint).....	250	215
Bulletin No. 62 (reprint).....	500	120
Bulletin No. 65 (reprint).....	1,000	744
Bulletin No. 66.....	2,000	1,700
Bulletin No. 67 (reprint).....	2,000	1,260
Bulletin No. 68.....	2,000	1,588
Bulletin No. 69, Part I.....	3,500	2,988
Bulletin No. 69, Part II.....	3,500	2,841
Bulletin No. 69, Part III.....	3,500	3,018
Bulletin No. 69, Part IV.....	3,500	2,924
Bulletin No. 69, Part V.....	3,500	2,818
Bulletin No. 70.....	14,500	14,055
Bulletin No. 71.....	1,000	1,000
Bulletin No. 72.....	4,000	1,940
Bulletin No. 73.....	1,000	1,000
Bulletin No. 74.....	1,600	1,415
Bulletin No. 75.....	10,000	7,380
Circular No. 6 (reprint).....	250	10
Circular No. 12.....	1,500	1,114
Report of Chemist for 1902.....	500	286
DIVISION OF ENTOMOLOGY.		
Bulletin No. 1 (new series, reprint).....	1,000	230
Bulletin No. 4 (new series, reprint).....	2,000	600
Bulletin No. 5 (new series, reprint).....	1,000	185
Bulletin No. 16 (new series, reprint).....	500	1,308
Bulletin No. 20 (new series, reprint).....	500	104
Bulletin No. 22 (new series, reprint).....	500	1,151
Bulletin No. 24 (new series, reprint).....	1,000	150
Bulletin No. 25 (new series, reprint).....	2,000	658
Bulletin No. 26 (new series, reprint).....	500	665
Bulletin No. 27 (new series, reprint).....	1,000	299
Bulletin No. 28 (new series, reprint).....	500	340
Bulletin No. 29 (new series, reprint).....	500	180
Bulletin No. 31 (new series, reprint).....	200	225
Bulletin No. 32 (new series, reprint).....	200	350
Bulletin No. 33 (new series, reprint).....	1,000	1,648
Bulletin No. 34 (new series, reprint).....	200	1,200
Bulletin No. 35 (new series, reprint).....	2,700	1,900
Bulletin No. 36 (new series, reprint).....	3,000	1,630
Bulletin No. 37 (new series, reprint).....	1,000	2,605
Reprint from Bulletin No. 37, A Partial List of the Coccidæ of Ohio.....	150	150
Reprint from Bulletin No. 37, On the Study of Forest Entomology in America.....	200	200
Reprint from Bulletin No. 37, Résumé of the Search for the Native Home of the San Jose Scale in Japan and China, etc.....	200	200
Bulletin No. 38 (new series).....	2,500	2,348
Reprint from Bulletin 38, The Southern Grain Louse.....	1,000	287
Reprint from Bulletin No. 38, The Tobacco Stalk Weevil.....	1,000	164
Reprint from Bulletin No. 38, Applied Entomology in Japan.....	100	100
Reprint from Bulletin No. 38, The Literature of American Economic Entomology.....	100	100
Bulletin No. 39.....	2,500	2,100
Bulletin No. 40.....	1,000	1,000
Reprint from Bulletin No. 40, Some Insect Inhabitants of the Stems of Elymus Canadensis, etc.....	100	100
Circular No. 20 (reprint).....	2,500	1,300
Circular No. 29 (reprint).....	3,500	600
Circular No. 31 (reprint).....	3,000	500
Circular No. 32 (reprint).....	2,500	1,600
Circular No. 35 (reprint).....	2,500	600
Circular No. 42 (reprint).....	3,500	2,000
Circular No. 46 (reprint).....	7,000	5,280
Circular No. 47 (reprint).....	5,000	6,400
Circular No. 49 (reprint).....	2,500	4,400
Circular No. 50 (reprint).....	5,000	2,760
Circular No. 51 (reprint).....	7,500	4,000
Circular No. 52 (reprint).....	3,500	3,083
Circular No. 53 (reprint).....	5,000	1,730
Report of the Acting Entomologist, 1902.....	500	120



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OFFICE OF EXPERIMENT STATIONS.		
Bulletin No. 28 (reprint).....	2, 000	1, 475
Bulletin No. 33 (reprint).....	1, 000	280
Bulletin No. 38 (reprint).....	500	580
Bulletin No. 45 (reprint).....	500	165
Bulletin No. 63 (reprint).....	500	212
Reprint from Bulletin No. 86, Irrigation in Utah.....	3, 000	2, 087
Bulletin No. 92 (reprint).....	500	188
Bulletin No. 96 (reprint).....	1, 000	598
Bulletin No. 98 (reprint).....	1, 000	300
Bulletin No. 100 (reprint).....	3, 000	660
Reprints from Bulletin No. 100:		
The Agricultural Situation in California.....	1, 000	474
The Irrigation Problems of Honey Lake Basin, California.....	500	350
Features and Water Rights of Yuba River, California.....	500	400
Irrigation Investigations on Cache Creek.....	500	300
Report of Irrigation Problems in the Salinas Valley.....	500	250
Irrigation from the San Joaquin River.....	500	310
Water Appropriations from Kings River.....	500	593
A Duty of Water Rights on the Los Angeles River, California.....	500	645
Problems of Water Storage on Torrential Streams of Southern California, etc.....	500	450
Reprints from Bulletin No. 104, Report of Irrigation Investigations for 1900:		
No. I. Review of the Work, by Elwood Mead.....	4, 000	1, 875
No. II. Irrigation on the Pecos River and its Tributaries, etc.....	4, 000	2, 369
No. III. Irrigation Investigation in Nevada.....	4, 000	1, 343
No. IV. Use of Water in Irrigation in the Yakima.....	4, 000	1, 339
Bulletin No. 105 (reprint).....	500	231
Bulletin No. 106 (reprint).....	1, 000	805
Bulletin No. 112.....	1, 000	935
Bulletin No. 113.....	5, 000	3, 746
Bulletin No. 115.....	1, 000	914
Reprints from Bulletin No. 115:		
Variation in Crossbred Wheats.....	200	85
Report of Section on Entomology.....	200	100
Agricultural College Libraries.....	200	200
Address of the President of the Association of American Agricultural Colleges and Experiment Stations.....	200	75
Report of Section on Horticulture and Botany.....	200	88
Cooperative Experiments with Grasses and Forage Plants.....	200	85
Artificial Plant Food Requirements of Soils.....	200	86
Irrigation in the Humid Regions.....	200	50
Range Improvement and Administration.....	200	90
A Year's Experience with Crude Petroleum.....	200	65
Florida Observations, Experimental Work.....	200	86
Life History of the Sugar Cane.....	200	85
Quantitative Studies on the Transmission of Parental Characters to Hybrid Offspring.....	200	50
Some Entomological Suggestions and Notes.....	200	60
Cooperation in Experimental Work Between the Station and Farmer.....	200	83
The Time of Emergence and Oviposition of the Spring Brood of the Hes- sian Fly.....	200	82
Aphids of the Apple, Pear, and Quince.....	200	48
Germination of Kentucky Blue Grass.....	200	200
Root Knot of the Cowpea.....	200	61
Insects of the Year in Massachusetts.....	200	56
Report of Section on Mechanic Arts.....	200	72
Bulletin No. 116.....	3, 500	2, 673
Bulletin No. 117.....	4, 000	2, 921
Bulletin No. 118.....	4, 000	2, 523
Bulletin No. 119.....	1, 000	1, 000
Reprint from Bulletin No. 119, Report of Irrigation Investigations for 1901:		
No. 1. Summary of Results, Irrigation in New Mexico, etc.....	2, 500	560
No. 2. California: Subterranean Water Supply of the San Bernardino Valley, etc.....	2, 500	800
No. 3. Idaho, Montana, Utah, and Colorado.....	2, 500	400
No. 4. Nebraska, Missouri, Wisconsin, and New Jersey, and Second Prog- ress Report on Silt Measurements.....	2, 500	575
Bulletin No. 120.....	1, 000	1, 000
Reprints from Bulletin No. 120:		
Minutes of the Seventh Annual Meeting of the American Association of Farmers' Institute Workers.....	1, 950	340
Papers, Addresses, and Discussions, Proceedings of the Seventh Annual Meeting of the American Association of Farmers' Institute Workers.....	4, 000	450
Constitutions and By-Laws of the American Association of Farmers' Insti- tute Workers, with Amendments Proposed at the Seventh Annual Meeting.....	200	200
Bulletin No. 121.....	2, 500	1, 689
Bulletin No. 122.....	3, 500	2, 030
Bulletin No. 123.....	1, 000	780

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OFFICE OF EXPERIMENT STATIONS—continued.		
Reprints from Bulletin No. 123:		
Report of Section on Horticulture and Botany .....	260	20
Report on Graduate School of Agriculture .....	200	25
Address of the President of the Association of American Agricultural Colleges and Experiment Stations .....	200	35
Tuskegee Normal Industrial Institute and Experiment Stations .....	200	17
The Graduate School of Agriculture, etc. ....	200	23
Agricultural Education in the South .....	200	20
Military Instruction in Land-Grant Colleges .....	200	25
Some of the Beef Problems of the South, and What the Stations can do toward Solving Them. ....	200	13
Station Experiments in Animal Breeding .....	200	10
What are the Breeding Problems and What Can the Station Do to Solve Them? .....	200	11
The Source of Carbohydrates from the South for the Production of Meat ..	200	75
Methods of Corn Breeding .....	200	17
Some Important Points in Plant Improvement .....	200	25
The Power Question in the South .....	200	121
Excellencies and Defects of Existing Legislation for the Control of Insect and Fungus Pests .....	200	35
The Need of Better Courses of Preparation for Work in Applied Botany ..	200	5
Plant Physiology and Pathology in College Curricula .....	200	40
The Editing of Experiment Stations Publications. Bulletin Illustration ..	200	15
Lines of Investigation Invitingly Open to Station Botanists .....	200	75
Plant Breeding to Secure Resistant Forms .....	200	31
Some Peculiar Needs in the New States, (a) Home Adornment, (b) Home Production .....	200	30
How far should the Experiment be Followed by Educational Effort on Part of Experimenter .....	200	5
Variety Testing .....	200	14
Recent Observations and Experiments with Insecticides for the San Jose Scale .....	200	76
The Method of Conducting Engineering Practice .....	200	60
Bulletin No. 124 .....	1,000	1,000
Bulletin No. 125 .....	5,000	4,159
Bulletin No. 126 .....	4,000	2,405
Bulletin No. 128 .....	3,000	2,051
Annual Report of the Office of Experiment Stations for the Year ended June 30, 1901 .....	1,000	826
Reprints from Annual Report of the Office of Experiment Stations for 1901:		
The Scope and Purpose of Irrigation Investigations of the Office of Experiment Stations .....	1,000	900
Annual Report of the Porto Rico Agricultural Experiment Station for 1901 .....	1,000	725
Annual Report of the Hawaii Agricultural Experiment Station for 1901 ..	1,000	700
Annual Report of the Alaska Agricultural Experiment Station for 1901 ..	2,000	1,900
Federal Legislation, Regulations, and Rulings Affecting Agricultural Colleges and Experiment Stations .....	1,000	160
Scope and Results of the Nutrition Investigations of the Office of Experiment Stations .....	1,000	475
Report on the Work and Expenditures of the Agricultural Experiment Stations for the Year ended June 30, 1901 .....	2,000	1,160
Annual Report of the Office of Experiment Stations for the Year ended June 30, 1902 .....	1,000	700
Farmers' Institutes in the United States .....	2,000	200
Reprints from Annual Report of the Office of Experiment Stations for 1902:		
Report of the Work and Expenditures of the Agricultural Experiment Stations for 1902 .....	2,000	900
Cooperation Between Experiment Stations and Farmers .....	1,000	925
Annual Report of the Alaska Agricultural Experiment Stations, 1902 .....	1,500	1,500
Annual Report of the Hawaii Agricultural Experiment Stations, 1902 .....	1,000	425
Review of Irrigation Investigations for 1902 .....	1,000	960
Some Features of Recent Progress in Agriculture and Agricultural Education .....	1,000	879
Annual Report of the Porto Rico Agricultural Experiment Stations, 1902. "Popular" Editions of Station Bulletins .....	1,000	550
Dietary Studies of Groups, Especially in Public Institutions .....	1,000	860
Bulletin No. 1, The Agricultural Experiment Station of Porto Rico: Its Establishment, Location, and Purpose .....	2,500	1,930
Boletín No. 1 (Spanish edition), La Estación de Experimentos Agrícolas de Puerto Rico, Su Establecimiento Sitio, y Propósito .....	3,000	2,500
Bulletin No. 2, Porto Rico Agricultural Experiment Stations. The Changa, or Mole Cricket .....	2,500	2,158
Boletín No. 2, Estación de Experimentos Agrícolas de Puerto Rico. La Changa, ó Grillotalpa ( <i>Scapteriscus didactylus</i> Latr.) en Puerto Rico. (Spanish edition) .....	3,000	2,608
Experiment Station Record, Vol. XIII, No. 9 .....	5,000	4,759
Experiment Station Record, Vol. XIII, No. 10 .....	5,000	4,596
Experiment Station Record, Vol. XIII, No. 11 .....	5,000	4,540

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OFFICE OF EXPERIMENT STATIONS—continued.		
Experiment Station Record, Vol. XIII, No. 12 .....	5,000	4,773
Experiment Station Record, Vol. XIV, No. 1 .....	5,000	4,955
Experiment Station Record, Vol. XIV, No. 2 .....	5,000	4,867
Experiment Station Record, Vol. XIV, No. 3 .....	5,000	4,839
International Conference on Plant Breeding and Hybridization. (Reprint from Experiment Station Record, Vol. XIV, No. 3) .....	200	200
Experiment Station Record, Vol. XIV, No. 4 .....	5,000	4,728
Experiment Station Record, Vol. XIV, No. 5 .....	5,000	4,805
Experiment Station Record, Vol. XIV, No. 6 .....	5,000	4,664
Experiment Station Record, Vol. XIV, No. 7 .....	5,000	4,600
Values in Science. (Reprint from Experiment Station Record, Vol. XIV, No. 7) .....	200	160
Experiment Station Record, Vol. XIV, No. 8 .....	5,000	4,597
Experiment Station Record, Vol. XIV, No. 9 .....	5,000	4,708
Experiment Station Record, Vol. XIV, No. 10 .....	5,000	4,059
Experiment Station Work, Vol. II, No. 1 .....	3,000	590
Experiment Station Work, Vol. II, No. 2 .....	3,000	328
Circular No. 32 .....	500	100
Circular No. 45 .....	500	260
Circular No. 46 (reprint) .....	1,000	1,275
Circular No. 49 .....	10,000	9,270
Circular No. 50 .....	2,000	1,180
Report of the Director of the Office of Experiment Stations, 1902 .....	3,000	2,397
DIVISION OF FOREIGN MARKETS.		
Bulletin No. 20 (reprint) .....	1,000	800
Bulletin No. 21 (reprint) .....	1,000	1,033
Bulletin No. 22 (reprint) .....	1,000	6,721
Bulletin No. 23 (reprint) .....	1,000	1,211
Bulletin No. 24 .....	1,000	902
Bulletin No. 25 .....	1,000	925
Bulletin No. 26 .....	6,500	6,391
Bulletin No. 28 .....	6,000	5,839
Bulletin No. 29 .....	6,000	5,925
Circular No. 25 .....	10,000	9,300
Report of Chief of Division of Foreign Markets for 1902 .....	500	140
BUREAU OF FORESTRY.		
Bulletin 6, No. 1 .....	5,000	2,000
Bulletin 8, No. 2 .....	5,000	1,850
Bulletin 10 (reprint) .....	5,000	1,800
Bulletin 13 .....	2,500	805
Bulletin 22 .....	1,000	800
Bulletin 28 .....	10,000	1,800
Bulletin 29 (reprint) .....	10,000	2,125
Bulletin 33 .....	10,000	6,425
Bulletin 34 .....	10,000	5,100
Bulletin 35 .....	10,000	7,143
Bulletin 36 .....	25,000	15,517
Bulletin 37 .....	10,000	9,216
Bulletin 38 .....	10,000	8,900
Bulletin 39 .....	10,000	7,033
Bulletin 40 .....	20,000	10,361
Bulletin 41 .....	10,000	7,412
Bulletin 42 .....	10,000	6,460
Circular No. 15 (reprint) .....	5,000	960
Circular No. 21 .....	3,000	3,824
Circular No. 24 .....	7,000	5,725
Report of the Forester for 1902 .....	15,000	9,840
Senate Document No. 84, Message from the President of the United States in Relation to the Rivers and Mountains of Southern Appalachian Region ...	5,500	3,800
LIBRARY.		
Bulletin No. 41 .....	1,000	837
Bulletin No. 42 .....	1,000	1,000
Bulletin No. 43 .....	1,000	920
Bulletin No. 44 .....	750	750
Bulletin No. 45 .....	1,000	741
Bulletin No. 46 .....	1,000	876
Report of the Librarian for 1902 .....	325	100
BUREAU OF PLANT INDUSTRY.		
Bulletin No. 14 .....	3,000	1,000
Bulletin No. 20 .....	3,000	2,864
Bulletin No. 21 .....	1,000	1,000
Bulletin No. 22 .....	4,200	1,610
Bulletin No. 23 .....	3,000	2,314
Bulletin No. 24 .....	5,000	2,354
Bulletin No. 26 .....	2,000	1,160



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BUREAU OF PLANT INDUSTRY—continued.		
Bulletin No. 27.....	2,500	.....
Bulletin No. 28.....	3,000	2,250
Bulletin No. 29.....	3,500	1,988
Bulletin No. 30.....	5,000	4,214
Bulletin No. 31.....	3,000	2,886
Bulletin No. 32.....	3,000	1,373
Bulletin No. 33.....	2,500	1,794
Bulletin No. 34.....	3,000	2,291
Bulletin No. 35.....	3,000	1,520
Bulletin No. 36.....	3,000	2,149
Bulletin No. 37.....	2,500	1,031
Bulletin No. 39.....	2,500	805
Bulletin No. 41.....	3,500	1,101
Bulletin No. 42.....	2,500	870
Report of the Chief of Bureau of Plant Industry, 1902.....	500	292
DIVISION OF POMOLOGY.		
Bulletin No. 5 (reprint).....	2,000	350
Bulletin No. 8.....	2,000	1,185
Bulletin No. 9.....	1,000	615
DIVISION OF PUBLICATIONS.		
Bulletin No. 6.....	1,000	774
Bulletin No. 7.....	1,000	907
Report of the Editor for 1902.....	1,500	1,175
Monthly List for June, 1902.....	75,000	74,600
Monthly List for July, 1902.....	75,000	74,500
Monthly List for August, 1902.....	75,000	74,400
Monthly List for September, 1902.....	76,000	75,600
Monthly List for October, 1902.....	75,000	74,500
Monthly List for November, 1902.....	78,000	77,600
Monthly List for December, 1902.....	83,000	82,500
Monthly List for January, 1903.....	100,000	99,600
Monthly List for February, 1903.....	100,000	99,500
Monthly List for March, 1903.....	100,000	99,500
Monthly List for April, 1903.....	100,000	99,600
Monthly List for May, 1903.....	110,000	109,500
List of Publications No. 179, ninth edition.....	10,000	9,000
List of Publications No. 179, tenth edition.....	10,000	5,000
List of Publications No. 247, eighth edition.....	5,000	3,900
OFFICE OF PUBLIC ROAD INQUIRIES.		
Bulletin No. 8 (reprint).....	3,000	3,381
Bulletin No. 9 (reprint).....	5,000	6,769
Bulletin No. 12 (reprint).....	5,000	4,825
Bulletin No. 17 (reprint).....	3,000	2,536
Bulletin No. 20.....	1,000	800
Bulletin No. 21 (reprint).....	5,000	9,183
Bulletin No. 22.....	15,000	15,000
Bulletin No. 23.....	25,000	21,147
Bulletin No. 24.....	10,000	10,000
Bulletin No. 25.....	15,000	12,795
Circular No. 21 (reprint).....	5,000	7,850
Circular No. 24.....	5,000	5,000
Circular No. 26 (reprint).....	5,000	4,633
Circular No. 27 (reprint).....	10,000	6,440
Circular No. 29 (reprint).....	1,000	1,975
Circular No. 32 (reprint).....	5,000	4,970
Circular No. 35 (reprint).....	5,000	4,370
Circular No. 36.....	5,000	230
Report of Office of Public Road Inquiries, 1902.....	1,500	546
BUREAU OF SOILS.		
Bulletin No. 21.....	5,000	3,514
Field Operations of the Bureau of Soils for 1901.....	8,000	7,927
Reprints from Field Operations of the Bureau of Soils for 1902:		
Soil Survey of the Westfield Area.....	1,000	254
Soil Survey of Allegan County, Michigan.....	1,000	700
Soil Survey of the Salem Area, New Jersey.....	1,000	500
Soil Survey of the Lebanon Area, Pennsylvania.....	1,000	468
Soil Survey of Prince George County, Maryland.....	1,000	292
Soil Survey of Harford County, Maryland.....	1,000	377
Soil Survey of the Bedford Area, Virginia.....	1,000	298
Soil Survey of the Prince Edward Area, Virginia.....	1,000	888
Soil Survey of the Statesville Area, North Carolina.....	1,000	677
Soil Survey of Alamance County, North Carolina.....	1,000	228
Soil Survey of Cobb County, Georgia.....	1,000	705

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Soil Survey of the Covington Area, Georgia.....	1,000	597
Soil Survey of Montgomery County, Tennessee.....	1,000	878
Soil Survey of the Yazoo Area, Mississippi.....	1,000	340
Soil Survey of the Yakima Area, Washington.....	1,000	239
Soil Survey of the Boise Area, Idaho.....	1,000	239
Soil Survey of the Hanford Area, California.....	1,000	287
Soil Survey of the Lower Salinas Valley, California.....	1,000	210
Soil Survey of the Ventura Area, California.....	1,000	275
Soil Survey of the San Gabriel Area, California.....	1,000	239
Soil Survey of the Imperial Area, California.....	1,000	312
Soil Survey of the Willis Area, Texas.....	1,000	769
Soil Survey of the Lake Charles Area, Louisiana.....	1,000	272
Report of the Chief of the Bureau of Soils, 1902.....	100	100
OFFICE OF THE SECRETARY.		
Annual Report of the Department of Agriculture for 1902.....	3,000	2,630
Report of Secretary for 1901 (reprint).....	300	75
Report of Secretary for 1902.....	5,000	4,522
Report No. 66 (reprint).....	300	200
Report No. 72.....	5,000	4,764
Report No. 73.....	40,000	36,624
Yearbook for 1902.....	30,000	7,150
Sugar-Beet Pulp as Animal Food (reprint from Report on Beet Sugar Industry for 1902).....	45,000	41,142
Single-Germ Beet Balls and Other Suggestions for Improving Sugar-Beet Culture (reprint from Report on Progress of Beet-Sugar Industry for 1902).....	45,000	40,479
DIVISION OF STATISTICS.		
Bulletin No 24.....	8,000	7,206
Crop Reporter, Vol. IV, No. 3.....	99,000	98,722
Crop Reporter, Vol. IV, No. 4.....	95,000	94,640
Crop Reporter, Vol. IV, No. 5.....	95,000	94,568
Crop Reporter, Vol. IV, No. 6.....	95,000	94,500
Crop Reporter, Vol. IV, No. 7.....	100,000	99,400
Crop Reporter, Vol. IV, No. 8.....	95,000	94,700
Crop Reporter, Vol. IV, No. 9.....	104,000	103,600
Crop Reporter, Vol. IV, No. 10.....	100,000	99,600
Crop Reporter, Vol. IV, No. 11.....	98,000	97,400
Crop Reporter, Vol. IV, No. 12.....	101,000	100,300
Crop Reporter, Vol. V, No. 1.....	104,000	103,500
Crop Reporter, Vol. V, No. 2.....	103,000	102,500
DIVISION OF VEGETABLE PHYSIOLOGY AND PATHOLOGY.		
Bulletin No. 8.....	1,000	360
Bulletin No. 13.....	1,000	1,000
Bulletin No. 16.....	1,000	150
Bulletin No. 19.....	1,000	390
Bulletin No. 23.....	1,000	580
Bulletin No. 24.....	1,000	612
EXTRACTS FROM YEARBOOKS.		
No. 37. The Meadow Lark and Baltimore Oriole.....	500	500
No. 83. Influence of Environment in Origination of Plant Varieties.....	1,000	55
No. 118. Object Lesson Roads.....	5,000	3,325
No. 137. Utilization of Residue from Beet-Sugar Manufacturing in Cattle Feeding.....	500	263
No. 192. Rabies: Causes, Frequency of Occurrence, and Treatment.....	1,000	200
No. 210. Mountain Roads.....	5,000	1,000
No. 227. The Prairie Dog of the Great Plains.....	5,000	1,050
No. 228. Some Typical Reservoirs in the Rocky Mountain States.....	900	875
No. 229. Little Known Fruit Varieties Considered Worthy of Wider Dissemination.....	1,500	729
No. 233. Some Problems of the Rural Common School.....	4,000	5,110
No. 236. The Timber Resources of Nebraska.....	5,000	9,407
No. 240. Road Building with Convict Labor in the Southern States.....	15,200	16,941
No. 242. Agriculture in the Tropical Islands of the United States.....	1,000	562
No. 243. The Present Status of the Mexican Cotton-Boll Weevil in the United States.....	1,000	977
No. 249. Working Plan for Southern Hardwoods and Its Results.....	11,500	9,200
No. 253. Mountain Roads as a Source of Revenue.....	5,000	3,397
No. 256. Wheat Ports of the Pacific Coast.....	2,000	376
No. 258. Statistical Matter.....	10,000	6,800
No. 259. A Directory for Farmers.....	2,500	1,000
No. 254. The Hemp Industry.....	1,000	617
No. 260. Dairying at Home and Abroad.....	3,000	370
No. 261. The San Jose Scale.....	500	500

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No. 262. The Contamination of Public Water Supplies by Algae .....	2,000	679
No. 263. Audubon Societies in Relation to the Farmer .....	1,000	420
No. 264. Industrial Progress in Plant Work .....	1,000	420
No. 265. Some Engineering Features of Drainage .....	1,500	420
No. 266. Top Working Orchard Trees .....	3,000	425
No. 267. The Educational Value of Live-Stock Exhibitions .....	100	94
No. 268. Some of the Principal Insect Enemies of Coniferous Forests in the United States .....	500	425
No. 269. Climate of the Forest-Denuded Portion of the Upper Lake Region .....	500	425
No. 270. Practicability of Forest Planting in the United States .....	15,000	11,800
No. 271. Wet and Dry Seasons in California .....	100	92
No. 272. Analysis of Waters and Interpretations of Results .....	1,000	375
No. 273. Distribution and Magnitude of the Poultry and Egg Industry .....	100	100
No. 274. The Influence of Forestry upon the Lumber Industry .....	15,000	12,323
No. 275. The Agaves: A Remarkable Group of Useful Plants .....	1,000	206
No. 276. Chemical Studies of Some Forest Products of Economic Importance .....	1,000	377
No. 277. Bacteria and the Nitrogen Problem .....	2,000	452
No. 278. Systems of Farm Management in the United States .....	10,000	481
No. 279. Improvement of Cotton by Seed Selection .....	20,000	13,085
No. 280. The Cost of Food as Related to Its Nutritive Value .....	3,000	489
No. 281. Grape, Raisin, and Wine Production in the United States .....	3,000	482
No. 282. Flaxseed Production, Commerce, and Manufacture in the United States .....	1,200	508
No. 283. Promising New Fruits .....	6,000	494
No. 284. Plants as a Factor in Home Adornment .....	5,000	376
No. 285. Progress in Secondary Education in Agriculture .....	3,000	482
No. 286. Selecting and Judging Horses for Market and Breeding Purposes .....	500	477
No. 287. Improvement in Corn by Seed Selection .....	10,000	376
No. 288. Tests on the Physical Properties of Timber .....	15,000	12,311
No. 289. Practices in Crop Rotation .....	3,500	2,942
No. 290. Fertilizers for Special Crops .....	2,000	476
No. 291. Crops Used in the Reclamation of Alkali Lands in Egypt .....	2,000	376
No. 292. Some Practical Results of Experiment Station Work .....	1,500	50
No. 293. Cultivation and Fertilization of Peach Orchards .....	2,000	491
No. 294. Rainfall and Irrigation .....	500	377
No. 295. Foot-and-Mouth Disease .....	4,000	1,691
No. 296. Use of Mineral Oil in Road Improvement .....	10,000	621
No. 297. A Directory for Farmers .....	10,000	1,182
No. 298. Statistical Matter Relating to Principal Crops and Farm Animals, Freight Rates, Exports, etc., of the United States .....	10,000	303
	3,686,225	3,659,752

*Farmers' Bulletins printed, and Congressional and miscellaneous distribution for the fiscal year 1902-1903.*

No. of bul- letin.	Title of bulletin.	Total number received.	Distributed to Con- gressmen.	Miscella- neous dis- tribution.
1	The What and Why of Agricultural Experiment Stations .....	1,000	.....	.....
2	The Work of Agricultural Experiment Stations .....	1,000	.....	.....
3	Culture of the Sugar Beet .....	1,000	.....	.....
4	Fungus Diseases of the Grape and Their Treatment .....	1,000	.....	.....
5	Treatment of Smuts of Oats and Wheat .....	1,000	.....	.....
6	Tobacco: Instructions for Its Culture and Curing .....	1,000	.....	110
7	Spraying Fruits for Insect Pests and Fungus Diseases .....	1,000	.....	.....
8	Results of Experiments with Inoculation for the Pre- vention of Hog Cholera .....	1,000	.....	.....
9	Milk Fermentations and Their Relations to Dairying .....	1,000	.....	.....
10	The Russian Thistle and Other Troublesome Weeds .....	1,000	.....	.....
11	The Rape Plant: Its History, Culture, and Uses .....	1,000	.....	161
12	Nostrums for Increasing the Yield of Butter .....	1,000	.....	.....
13	Cranberry Culture .....	1,000	.....	.....
14	Fertilizers for Cotton .....	1,000	14	55
15	Some Destructive Potato Diseases .....	1,000	.....	.....
16	Leguminous Plants .....	46,000	9,721	11,024
17	Peach Yellows and Peach Rosette .....	.....	560	771
18	Forage Plants of the South .....	1,000	.....	.....
19	Important Insecticides .....	1,000	.....	.....
20	Washed Soils .....	1,000	1,257	852
21	Barnyard Manure .....	30,000	31,281	10,614
22	The Feeding of Farm Animals .....	100,000	58,686	15,568



*Farmers' Bulletins printed, and Congressional and miscellaneous distribution for the fiscal year 1902-1903—Continued.*

No. of bulletin.	Title of bulletin.	Total number received.	Distributed to Congressmen.	Miscellaneous distribution.
23	Foods: Nutritive Value and Cost .....	1, 000		
24	Hog Cholera and Swine Plague .....	105, 200	60, 272	13, 557
25	Peanuts: Culture and Uses .....	45, 000	7, 431	10, 246
26	Sweet Potatoes: Culture and Uses .....	1, 000		
27	Flax for Seed and Fiber .....	30, 000	3, 307	4, 978
28	Weeds and How to Kill Them .....	70, 000	35, 983	5, 795
29	Souring of Milk and Other Changes .....	45, 000	23, 844	7, 924
30	Grape Diseases of the Pacific Coast .....	45, 000	2, 825	3, 964
31	Alfalfa or Lucern .....	50, 000	39, 502	14, 342
32	Silos and Silage .....	75, 000	28, 974	11, 249
33	Peach Growing for Market .....	45, 000	18, 750	12, 431
34	Meats: Composition and Cooking .....	45, 000	20, 507	9, 499
35	Potato Culture .....	85, 000	51, 336	16, 003
36	Cotton Seed and Its Products .....	30, 000	15, 841	6, 928
37	Kafir Corn: Culture and Uses .....	30, 000	13, 338	8, 744
38	Spraying for Fruit Diseases .....	50, 000	34, 514	16, 244
39	Onion Culture .....	45, 000	22, 018	15, 911
40	Farm Drainage .....	39, 200	28, 833	12, 357
41	Fowls: Care and Feeding .....	1, 000		
42	Facts About Milk .....	40, 000	37, 492	12, 407
43	Sewage Disposal on the Farm .....	30, 000	6, 070	7, 955
44	Commercial Fertilizers .....	55, 200	28, 775	12, 306
45	Insects Injurious to Stored Grain .....	30, 000	19, 845	6, 937
46	Irrigation in Humid Climates .....		4, 393	4, 245
47	Insects Affecting the Cotton Plant .....	45, 000	17, 701	5, 011
48	The Manuring of Cotton .....	30, 000	23, 704	7, 390
49	Sheep Feeding .....	30, 000	29, 247	14, 805
50	Sorghum as a Forage Crop .....	30, 000	16, 407	9, 186
51	Standard Varieties of Chickens .....	136, 200	93, 441	19, 272
52	The Sugar Beet .....	65, 000	40, 769	12, 433
53	How to Grow Mushrooms .....	30, 000	9, 884	11, 077
54	Some Common Birds .....	50, 300	36, 365	16, 684
55	The Dairy Herd .....	80, 400	52, 038	12, 345
56	Experiment Station Work—I .....	30, 000	19, 549	8, 269
57	Butter Making on the Farm .....	70, 000	49, 043	15, 811
58	The Soy Bean as a Forage Crop .....	30, 000	12, 969	8, 755
59	Bee Keeping .....	30, 000	19, 913	14, 794
60	Methods of Curing Tobacco .....	30, 000	19, 081	6, 108
61	Asparagus Culture .....	45, 000	18, 332	11, 857
62	Marketing Farm Produce .....	50, 000	32, 733	9, 429
63	Care of Milk on the Farm .....	45, 000	42, 088	13, 375
64	Ducks and Geese .....	75, 000	50, 680	16, 097
65	Experiment Station Work—II .....	30, 000	17, 882	10, 397
66	Meadows and Pastures .....	40, 000	26, 867	11, 409
67	Forestry for Farmers .....	1, 000		
68	The Black Rot of the Cabbage .....	30, 000	13, 330	8, 283
69	Experiment Station Work—III .....	30, 000	16, 287	8, 364
70	Insect Enemies of the Grape .....	58, 000	11, 502	10, 024
71	Essentials in Beef Production .....	50, 000	29, 370	7, 379
72	Cattle Ranges of the Southwest .....		10, 608	5, 171
73	Experiment Station Work—IV .....	30, 000	16, 714	7, 013
74	Milk as Food .....	55, 000	30, 690	13, 347
75	The Grain Smuts .....	40, 000	16, 400	12, 624
76	Tomato Growing .....	55, 000	29, 981	14, 662
77	The Liming of Soils .....	44, 500	16, 744	10, 160
78	Experiment Station Work—V .....		18, 940	7, 376
79	Experiment Station Work—VI .....	30, 000	15, 893	7, 250
80	The Peach Twig-borer .....	45, 000	9, 697	8, 043
81	Corn Culture in the South .....	30, 000	25, 395	9, 567
82	The Culture of Tobacco .....	45, 000	23, 898	8, 323
83	Tobacco Soils .....	30, 000	17, 357	7, 059
84	Experiment Station Work—VII .....		20, 970	7, 440
85	Fish as Food .....	30, 000	13, 866	9, 759
86	Thirty Poisonous Plants .....	30, 000	20, 192	15, 037
87	Experiment Station Work—VIII .....	30, 000	15, 865	6, 988
88	Alkali Lands .....	30, 000	5, 996	5, 306
89	Cowpeas .....	50, 000	33, 019	11, 448
90	The Manufacture of Sorghum Sirup .....	1, 000		
91	Potato Diseases and Their Treatment .....	65, 000	40, 062	9, 848
92	Experiment Station Work—IX .....	30, 000	14, 207	6, 652
93	Sugar as Food .....	30, 000	10, 178	10, 118
94	The Vegetable Garden .....	75, 000	45, 888	20, 218
95	Good Roads for Farmers .....	125, 326	82, 898	20, 166
96	Raising Sheep for Mutton .....	55, 000	36, 095	14, 186
97	Experiment Station Work—X .....	30, 000	15, 235	7, 106
98	Suggestions to Southern Farmers .....	50, 000	22, 485	13, 134
99	Insect Enemies of Shade Trees .....	30, 000	17, 055	8, 096
100	Hog Raising in the South .....	50, 000	31, 261	14, 838
101	Millet .....	30, 000	18, 895	8, 378
102	Southern Forage Plants .....	45, 000	24, 035	9, 911

*Farmers' Bulletins printed, and Congressional and miscellaneous distribution for the fiscal year 1902-1903—Continued.*

No. of bulletin.	Title of bulletin.	Total number received.	Distributed to Congressmen.	Miscellaneous distribution.
103	Experiment Station Work—XI .....	30,000	18,522	7,208
104	Notes on Frost .....	44,800	13,507	7,798
105	Experiment Station Work—XII .....	30,000	15,556	7,082
106	Breeds of Dairy Cattle .....	125,600	83,578	17,562
107	Experiment Station Work—XIII .....	40,300	16,441	7,069
108	Saltbushes .....	.....	1,656	3,980
109	Farmers' Reading Courses .....	50,000	38,746	11,405
110	Rice Culture in the United States .....	10,000	9,616	6,430
111	The Farmers' Interest in Good Seed .....	40,000	31,232	9,759
112	Bread and Bread Making .....	65,000	38,093	13,817
113	The Apple and How to Grow It .....	105,000	61,456	17,230
114	Experiment Station Work—XIV .....	30,000	18,090	9,051
115	Hop Culture in California .....	.....	2,559	2,709
116	Irrigation in Fruit Growing .....	10,000	15,808	6,914
117	Sheep, Hogs, and Horses in the Northwest .....	40,000	24,572	11,343
118	Grape Growing in the South .....	30,000	28,250	9,525
119	Experiment Station Work—XV .....	30,000	18,415	8,889
120	Insects Affecting Tobacco .....	.....	13,608	5,105
121	Beans, Peas, and Other Legumes as Food .....	60,000	37,114	14,558
122	Experiment Station Work—XVI .....	30,000	20,607	7,791
123	Red Clover Seed .....	30,000	22,604	9,725
124	Experiment Station Work—XVII .....	45,000	22,294	8,468
125	Protection of Food Products from Injurious Temperatures .....	30,000	17,169	7,598
126	Practical Suggestions for Farm Buildings .....	110,000	74,261	12,451
127	Important Insecticides .....	50,000	21,286	11,656
128	Eggs and Their Uses as Food .....	65,000	52,827	13,080
129	Sweet Potatoes .....	60,000	38,170	11,604
130	The Mexican Cotton Boll Weevil .....	30,000	10,882	5,816
131	Household Tests for Detection of Oleomargarine and Renovated Butter .....	30,000	15,268	7,226
132	Insect Enemies of Growing Wheat .....	40,500	34,130	6,909
133	Experiment Station Work—XVIII .....	30,000	34,305	8,156
134	Tree Planting in Rural School Grounds .....	40,000	28,751	9,373
135	Sorghum Sirup Manufacture .....	30,000	21,079	7,083
136	Earth Roads .....	120,000	73,925	22,029
137	The Angora Goat .....	55,000	30,906	14,185
138	Irrigation in Field and Garden .....	30,000	26,211	8,096
139	Emmer: A Grain for the Semiarid Regions .....	30,000	11,071	4,226
140	Pineapple Growing .....	.....	4,801	4,270
141	Poultry Raising on the Farm .....	140,100	111,430	23,773
142	The Nutritive Value of Food .....	50,000	41,130	13,587
143	The Conformation of Beef and Dairy Cattle .....	90,000	63,804	13,056
144	Experiment Station Work—XIX .....	40,000	30,867	8,675
145	Carbon Bisulphid as an Insecticide .....	30,000	10,222	25,150
146	Insecticides and Fungicides .....	30,000	19,197	7,738
147	Winter Forage Crops for the South .....	40,000	39,261	10,734
148	Celery Culture .....	50,000	31,905	11,887
149	Experiment Station Work—XX .....	40,000	41,318	10,438
150	Clearing New Land .....	51,000	30,066	23,631
151	Dairying in the South .....	30,000	25,675	10,036
152	Scabies in Cattle .....	50,000	52,846	8,781
153	Orchard Enemies in the Northwest .....	30,000	21,142	7,121
154	The Home Fruit Garden: Preparation and Care .....	90,000	69,913	14,588
155	How Insects Affect Health in Rural Districts .....	45,000	34,015	12,446
156	The Home Vineyard .....	65,000	30,091	20,557
157	Propagation of Plants .....	55,000	25,175	14,588
158	How to Build Small Irrigation Ditches .....	40,000	15,661	10,785
159	Scab in Sheep .....	30,000	.....	.....
160	Game Laws for 1902 .....	65,000	26,401	33,622
161	Practical Suggestions for Fruit Growers .....	55,000	32,785	13,134
162	Experiment Station Work—XXI .....	50,000	24,880	8,310
163	Methods of Controlling the Boll Weevil .....	125,000	104,526	5,934
164	Rape as a Forage Crop .....	45,000	5,221	9,902
165	Culture of the Silkworm .....	20,000	260	3,628
166	Cheese Making on the Farm .....	40,000	6,515	19,015
167	Cassava .....	25,000	619	5,262
168	Pearl Millets .....	20,000	1,562	5,041
169	Experiment Station Work—XXII .....	30,000	1,377	6,119
170	Principles in Horse Feeding .....	60,000	4,252	22,220
171	The Control of the Codling Moth .....	30,000	.....	6,342
172	Scale Insects and Mites on Citrus Trees .....	20,000	224	5,962
173	A Primer of Forestry .....	30,000	.....	.....
174	Broom Corn .....	30,000	.....	.....
175	Home Manufacture and Use of Unfermented Grape Juice .....	30,000	200	1,885
176	Cranberry Culture .....	30,000	.....	.....
177	Squab Raising .....	30,000	.....	.....
Total .....		6,845,626	3,954,976	1,592,008

*Publications received and distributed by the Weather Bureau during the year ended June 30, 1903, by quarters.*

Number and title of publication.	Number of copies.
QUARTER ENDED SEPTEMBER 30, 1902.	
<i>Received.</i>	
No. 265. Bulletin No. 31. Proceedings of the Second Convention of Weather Bureau Officials, held at Milwaukee, Wis., August 27, 28, 29, 1901.....	5,000
No. 268. Bulletin No. 32. Hurricanes: Especially those of Porto Rico and St. Kitts.....	2,000
No. 269. Monthly Weather Review for April, 1902.....	4,600
No. 270. Monthly Weather Review for May, 1902.....	4,600
No. 271. Monthly Weather Review for June, 1902.....	4,600
Weather Bureau Bulletins (bound), 21 to 30.....	20
Washington Daily Weather Maps.....	138,035
Climate and Crop Bulletins.....	63,464
<i>Distributed.</i>	
Report of the Chief of the Weather Bureau, 1898-99, Part I.....	2
Report of the Chief of the Weather Bureau, 1898-99, Part II.....	5
Report of the Chief of the Weather Bureau, 1899-1900.....	2
Report of the Chief of the Weather Bureau, 1900-1901, Part I.....	2
Separates from Report of the Chief of the Weather Bureau, 1899-1900.....	8
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Bulletin No. 28.....	2
Bulletin No. 30.....	12
Bulletin C.....	4
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Bulletin J.....	90
Description of Cloud Forms.....	24
Weather Bureau Bulletins (bound), Nos. 21 to 30, inclusive.....	20
Washington Daily Weather Maps.....	138,035
Climate and Crop Bulletins.....	63,464
No. 265. Bulletin No. 31. Proceedings of the Second Convention of Weather Bureau Officials, held at Milwaukee, Wis., August 27, 28, 29, 1901.....	4,983
No. 267. Bulletin I. Eclipse Meteorology and Allied Problems.....	1,398
No. 268. Bulletin No. 32. Hurricanes: Especially those of Porto Rico and St. Kitts.....	1,787
No. 269. Monthly Weather Review for April, 1902.....	4,550
No. 270. Monthly Weather Review for May, 1902.....	4,550
No. 271. Monthly Weather Review for June, 1902.....	4,550
QUARTER ENDED DECEMBER 31, 1902.	
<i>Received.</i>	
No. 272. Monthly Weather Review for July, 1902.....	4,600
No. 273. Studies on the Statics and Kinematics of the Atmosphere in the United States.....	500
No. 274. Monthly Weather Review for August, 1902.....	4,600
No. 275. Monthly Weather Review for September, 1902.....	4,600
No. 276. Monthly Weather Review for October, 1902.....	4,800
No. 80. Instructions to Storm-Warning Displaymen of the Weather Bureau (edition of 1902).....	1,000
Instructions to Special River and Rainfall Observers of the Weather Bureau (edition of 1902).....	1,000
Washington Daily Weather Maps.....	137,935
Climate and Crop Bulletins.....	9,890
Washington Daily Weather Maps (bound), January 1, 1901, to June 30, 1901.....	100
Washington Daily Weather Maps (bound), July 1, 1901, to December 31, 1901.....	100
Part II, Report of the Chief of the Weather Bureau for 1901-1902.....	50
Part III, Report of the Chief of the Weather Bureau for 1901-1902.....	300
Part IV, Report of the Chief of the Weather Bureau for 1901-1902.....	300
Part V, Report of the Chief of the Weather Bureau for 1901-1902.....	300
Part VI, Report of the Chief of the Weather Bureau for 1901-1902.....	300
<i>Distributed.</i>	
Report of the Chief of the Weather Bureau, 1901-1902.....	1
Report of the Chief of the Weather Bureau, 1893.....	3
Report of the Chief of the Weather Bureau, 1894.....	3
Report of the Chief of the Weather Bureau, 1895-96.....	2
Report of the Chief of the Weather Bureau, 1896-97.....	1
Report of the Chief of the Weather Bureau, 1897-98.....	1
Report of the Chief of the Weather Bureau, 1898-99, Part I.....	2
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*Publications received and distributed by the Weather Bureau during the year ended June 30, 1903, by quarters—Continued.*

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Bulletin C.....	8
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Description of Cloud Forms.....	56
No. 272. Monthly Weather Review for July, 1902.....	4,550
No. 273. Studies on the Statics and Kinematics of the Atmosphere in the United States.....	500
No. 274. Monthly Weather Review for August, 1902.....	4,550
No. 275. Monthly Weather Review for September, 1902.....	4,550
No. 276. Monthly Weather Review for October, 1902.....	4,750
No. 80. Instructions to Storm-Warning Displaymen (edition 1902).....	1,000
Instructions to Special River and Rainfall Observers (edition of 1902).....	1,000
Washington Daily Weather Maps.....	137,935
Climate and Crop Bulletin.....	9,890
QUARTER ENDED MARCH 31, 1903.	
<i>Received.</i>	
No. 277. Instructions for obtaining and tabulating records from recording instruments. Circular A, Instrument Division.....	1,500
No. 278. Monthly Weather Review for November, 1902.....	4,800
No. 279. Monthly Weather Review for December, 1902.....	4,800
No. 280. Meteorological Chart of the Great Lakes, No. 2, 1902.....	2,500
No. 281. Monthly Weather Review and Annual Summary, 1902.....	4,800
No. 282. Monthly Weather Review for January, 1903.....	4,800
Washington Daily Weather Maps.....	139,280
Climate and Crop Bulletins.....	14,785
Snow and Ice Charts.....	19,900
Washington Daily Weather Maps (bound), January 1, 1902, to June 30, 1902.....	100
Washington Daily Weather Maps (bound), July 1, 1902, to December 31, 1902.....	100
Chapters 1, 2, 6, and 8, Volume II, Annual Report of Chief of the Weather Bureau.....	500
<i>Distributed.</i>	
Report of the Chief of the Weather Bureau, 1891-92.....	2
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*Publications received and distributed by the Weather Bureau during the year ended June 30, 1903, by quarters—Continued.*

Number and title of publication.	Number of copies.
QUARTER ENDED MARCH 31, 1903—continued.	
<i>Distributed—Continued.</i>	
No. 277. Circular A, Instrument Division .....	372
No. 278. Monthly Weather Review for November, 1902 .....	4,750
No. 279. Monthly Weather Review for December, 1902 .....	4,750
No. 280. Meteorological Chart of the Great Lakes, No. 2, 1902 .....	2,464
No. 281. Monthly Weather Review and Annual Summary, 1902 .....	4,712
No. 282. Monthly Weather Review for January, 1903 .....	4,750
Washington Daily Weather Maps .....	139,280
Climate and Crop Bulletins .....	14,785
snow and Ice Charts .....	19,900
Washington Daily Weather Maps (bound), January 1, 1902, to June 30, 1902 .....	100
Washington Daily Weather Maps (bound), July 1, 1902, to December 31, 1902 .....	100
Chapters 1, 2, 6, and 8, Volume II, Annual Report of Chief of the Weather Bureau .....	500
QUARTER ENDED JUNE 30, 1903.	
<i>Received.</i>	
No. 283. Monthly Weather Review for February, 1903 .....	4,800
No. 284. Monthly Weather Review for March, 1903 .....	4,800
No. 285. Measurement of Precipitation, Circular E, Instrument Division .....	1,000
No. 286. Meteorological Chart of the Great Lakes, No. 1, 1903 .....	2,500
No. 287. Monthly Weather Review for April, 1903 .....	4,800
No. 288. Storms of the Great Lakes, Bulletin K .....	2,000
Washington Daily Weather Maps .....	142,680
Climate and Crop Bulletins .....	59,040
<i>Distributed.</i>	
Report of the Chief of the Weather Bureau, 1891-92 .....	3
Report of the Chief of the Weather Bureau, 1893 .....	2
Report of the Chief of the Weather Bureau, 1894 .....	3
Report of the Chief of the Weather Bureau, 1895-96 .....	2
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## REPORT OF THE ACTING STATISTICIAN.

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U. S. DEPARTMENT OF AGRICULTURE,  
BUREAU OF STATISTICS,  
*Washington, D. C., October 20, 1903.*

SIR: I have the honor to submit herewith a report on the organization and work of the Division of Statistics for the fiscal year ending June 30, 1903.

Respectfully,

EDWIN S. HOLMES, Jr.,  
*Acting Chief of Bureau.*

Hon. JAMES WILSON, *Secretary.*

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### THE GENERAL WORK OF THE DIVISION.

#### EARLY RECOGNITION BY CONGRESS OF THE NEED FOR AGRICULTURAL STATISTICS.

Sixty-four years ago Congress for the first time made provision for the collection of agricultural statistics. There was no Department of Agriculture for twenty-two years and no Department of the Interior for nine years after the commencement of this work; so, for convenience of administration, a Division of Agriculture was established in the Patent Office, then a part of the Department of State, with the collection of agricultural statistics as its principal duty. It is worthy of note that when as yet there was no recognition of the necessity of any systematic effort to eradicate those destructive animal and vegetable diseases which have entailed a loss of billions of dollars upon American agriculture, and when other important functions of the Department of Agriculture as it exists to-day were hardly dreamed of, there was a distinct realization by Congress of the necessity of furnishing the country with early intelligence concerning the condition and prospects of growing crops and with prompt and definite reports as to the volume and value of those crops when harvested.

#### METHODS OF COLLECTING AGRICULTURAL STATISTICS.

There are two principal methods of collecting agricultural statistics, and in the United States the use of both methods dates back to the same year. One is the census method, by which every farm is visited by an enumerator and the desired information obtained from the farmer or from some member of his family. This method, while liable to error arising from the forgetfulness of the farmer, the incapacity or carelessness of the enumerator, and other causes, should give results closely approximating the facts, and such results have been



used by the Department of Agriculture in past years as a check upon figures obtained through its own agencies by the alternative method. But the magnitude of the work involved in the analysis and compilation of a separate report from every farm in the country seriously delays the ascertainment and publication of results.

The alternative method is that which is employed, with unimportant modifications, by the Governments of all the great agricultural countries of the world. It consists in having representative and well-informed farmers, together with other persons whose opportunities for forming an accurate judgment entitle their opinions to consideration, report from month to month as to the agricultural conditions obtaining in their respective districts. This was the method used in the Division of Agriculture in the Patent Office sixty-four years ago and continued when a separate Department of Agriculture was organized in 1862. It admits of the prompt publication of the information obtained, and, while it is not denied that there have been occasions during the long history of the Department when it has failed to keep step with the amazing development of our American agriculture, its general reliability has been clearly demonstrated whenever it has been practicable to compare its results with those obtained by more exact and laborious methods.

#### THE CROP-REPORTING METHODS OF THE DIVISION OF STATISTICS.

As already stated, the principal feature of the crop-reporting system of the Division of Statistics is the correspondence of a large number (upward of 250,000) of farmers, bankers, merchants, cotton ginners, agents of transportation lines, mill and elevator proprietors, and other persons. The actual number of persons thus reporting, however, great though it is, does not constitute the strength and value of the system so much as the fact that various interests are represented in it and that the use of different geographical units (State, county, township, etc.) affords an additional check.

The organization includes 38 State statistical agents, receiving compensation at the rate of from \$300 to \$800 per annum. Each of these maintains a corps of correspondents entirely independent of those reporting directly to the Department at Washington, and such correspondents, ranging in number from 21 in Delaware to 517 in Michigan, aggregate about 9,000. The State statistical agent does something more than merely tabulate the reports of his correspondents, or the work could be done just as well in Washington. He analyzes and coordinates them in the light of his own knowledge of conditions derived from personal observation and other sources.

In each agricultural county the Division of Statistics has a correspondent who makes the county the geographical unit of his reports. Every such correspondent has from two to four assistant correspondents whose duty it is to keep him informed as to the agricultural conditions prevailing in their respective districts. These county correspondents and subcorrespondents number about 11,000.

In every township and voting precinct in the United States in which farming operations of any kind are carried on the Division of Statistics has a correspondent who makes such township or precinct the basis of his reports. These correspondents number, approximately, 30,000.

The State statistical agents and their correspondents, together with the county and township correspondents, numbering in all 50,000, report eleven times in each year.

For the purpose of rendering his cotton reports more complete and reliable, the Statistician also corresponds during the growing and picking season with public and private ginneries, bankers, merchants, and other persons not actual cotton growers.

Similarly, as a check upon the reports on cereal production, he utilizes the services of about 24,000 millers, elevator men, and other nonfarmers.

Seven special cotton agents, stationed at as many principal Southern cotton markets and paid a compensation of from \$20 to \$50 per month each, report weekly as to the receipts and shipments of cotton. Every transportation line in the South reports the amount of cotton it carries, with the points of origin and destination, and Southern mills, without a single exception, report their purchases of cotton during the year, for use in the preparation of the final cotton report, issued as soon after the close of the cotton year as the necessary data can be collected and compiled.

Finally, at the end of the growing season, more than 84,000 farmers and planters report on the results of their own individual farming operations during the year, and about 22,000 agents of railroad and other transportation lines report as to shipments and stocks of cotton.

The number of statistical correspondents of all classes in the cotton States, inclusive of railroad and other transportation agents, is about 147,000, and the total number in all the States and Territories in the Union aggregates 256,000.

The Division of Statistics has also six special field agents, whose duty it is to watch carefully the development of each important crop of the United States throughout the entire period of its growth and to keep in close touch with the best-informed opinion in regard to conditions and prospects.

The reports received from all these various sources are not dealt with in mass, but those of each class are separately tabulated, with a view to the determination, for the Statistician's future guidance, of their respective approximations to accuracy.

The total number of reports handled by the 75 employees of the Division of Statistics in Washington has been as high as 2,500,000 in a single year. It is only because the various agencies employed in the collection of this immense amount of statistical material are, except as above stated, voluntary agencies that the magnitude of the Department's crop-reporting organization and its possibilities of increased usefulness are not more adequately recognized. But, as already stated, the promptitude with which the information thus gathered is made public constitutes its chief value, and neither the clerical force in Washington nor the number of statistical experts is adequate to that further use of these various agencies for which there is so much need.

The Statistician's reports cover the acreage, production, and farm value of corn, wheat, oats, barley, rye, buckwheat, cotton, tobacco, flaxseed, potatoes, and hay, and the number and value of farm animals.

It is impossible to determine the separate cost either of collecting or of tabulating the statistics of any particular product, but during each year cotton is reported upon seven times, wheat eight times, corn and oats each six times, and other products from two to eight times each.

## METHODS OF HANDLING REPORTS.

The different steps taken in the preparation of each monthly crop report are as follows: Correspondents' reports are sent to the Statistician by mail in sealed envelopes. The figures reported are transferred from the schedules to tabulating sheets, where they are given proper arithmetical weight according to the acreage or production of the county they represent. State averages are then determined and the computations verified. The reports of county, township, and other correspondents are tabulated in separate sections, working in separate rooms. State statistical agents' reports, based on the returns of their correspondents, are made up by those persons themselves and mailed under a special-delivery stamp direct to the Statistician, who locks them up with their seals unbroken until the day on which the report is issued, and they do not leave his hands until after the report of which they form a part has been made public.

State statistical agents residing at points more than 500 miles distant from Washington report by telegraph in cipher. The tabulated reports of the different classes of correspondents are transcribed on the day on which the crop report is issued by clerks in the Statistician's private room, being copied in parallel columns for their more convenient analysis and harmonization. The determination of the official figures is made by the Statistician, the ultimate averages of all the more important crops being worked out behind closed doors during the two or three hours immediately preceding the time appointed for their publication, and during the time when the Statistician is engaged on this work no one is permitted to enter or leave his room.

Valuable special reports are also made from time to time on the cost of production, cost of transportation, farm labor, and other subjects of interest to the farmer and the country in general that can be properly reported upon by the Department's correspondents or special agents.

## SCOPE OF CROP REPORTS.

Eleven reports on the principal crops are received each year from county correspondents, State statistical agents, and township correspondents, and one report relating to the acreage and production of general crops is received during the year from individual farmers.

Six special cotton reports are received during the growing season from county correspondents, State statistical agents, and township correspondents, and the first and last of these reports are supplemented by returns from individual farmers, special correspondents, and cotton ginnerers.

## FOREIGN AGRICULTURAL STATISTICS—THEIR IMPORTANCE AND METHOD ADOPTED TO OBTAIN AND PUBLISH THEM PROMPTLY.

It is not sufficient that the people of the United States should be properly informed, first, as to the prospective, and, afterwards, as to the approximately ascertained volume of the principal crops of the country. Our enormous surplus production renders it of equal importance that we should know what is likely to be the production of competing countries and the demand for American products in the markets of the world. For the more prompt attainment of this important



object, the Division of Statistics has a special agent of long experience in work of this kind resident in London, where he is in close official touch with the statistical offices of the different European Governments, and secures early and accurate information relative to the crops of the different countries for transmission to Washington by cable.

The importance of this work is accentuated by the supreme efforts that are now being made by certain foreign countries to develop the natural resources of their own possessions, in order to render themselves independent of the United States for their food supplies and the raw material for their manufacturing industries.

While the cultivation of friendly relations with the statistical offices of foreign Governments has secured for the Department during the last few years facilities for reporting upon foreign crops superior to those in its possession at any previous period in its history, the need has been felt of a still more prompt transmittal to this office of authoritative information relative to the condition and prospects of such crops as enter into competition with those of the United States in the world's markets.

Negotiations with the Governments of various important grain-producing countries of Europe, and also with that of the Dominion of Canada, looking to a telegraphic interchange of crop reports, similar to that already in operation between the United States and Hungary, have been continued, and it is now believed that those negotiations have reached a stage which gives promise that the growing season of another year will see the American farmer placed in as prompt possession of trustworthy statistics concerning the principal grain crops of foreign countries as he is of those of the United States.

#### WORK OF THE YEAR.

In addition to the regular work in estimating crop conditions, etc., statistical matter relating to the principal crops and farm animals, freight rates, exports, etc., in the United States and foreign countries has been prepared for publication in the Yearbook, and numerous inquiries from various interested persons, as well as Bureaus and Divisions of this Department, have been replied to, thus necessitating a vast amount of research and compilation. Several special reports have also been published during the year. These reports include a statistical description of the "Wheat ports of the Pacific coast;" "Practices in crop rotation;" "Flaxseed production, commerce, and manufacture in the United States;" "Milk transportation: Freight rates to the largest fifteen cities in the United States," and "Relations of population and food products in the United States."

#### COST OF CROP PRODUCTION.

On January 1, 1902, the Department of Agriculture, through the Minnesota experiment station, began some statistical investigations to determine as accurately as possible the cost of production per acre of each of the different farm crops. The method of procedure was to keep a labor and financial account with about fifty farms, having a total of nearly 12,000 acres. These farms were visited each day, and an accurate record made, showing the number of hours worked by man and horse on each field and each crop, the cost of keeping hired men, and the cost of keeping work horses; and, using these factors, it was

possible to translate the labor records into figures of dollars and cents and determine the value of a man-hour and also of a horse-hour. From the financial records kept it was possible to estimate the depreciation in the value of farm machinery, the rental value of land, the cost of binding twine, seed, etc.; and from the sum total of these figures an accurate estimate of the complete cost to the farmer of producing his crops has been made. Also estimates of average yields of all crops and their market values were secured, so that the market value of an acre of each particular crop might be compared with the cost of production, and the net profit to the farmer shown.

Although this work is not sufficiently complete to admit of the publication of results at the present time, these data, when properly tabulated and analyzed, will undoubtedly prove of great value in solving questions of farm management and various other problems that confront the modern farmer.

#### COOPERATION WITH OTHER BUREAUS AND DIVISIONS.

During the year there has been a close cooperation between the Division of Statistics and the Bureau of Plant Industry, the Bureau of Animal Industry, the Bureau of Forestry, and the Bureau of Soils, and such cooperation and mutual dependence will be even greater in the future than they have been in the past. Throughout the whole of the research work of the Department, the best results have been attained by the cooperation of one set of specialists with another. The statistical work contained in the various publications of the different branches of the Department of Agriculture is largely done by the clerks of the Division of Statistics, and such statistical work as is not done in this Division is carefully revised by the Statistician and receives his approval before being published.

#### THE STATISTICAL LIBRARY.

While there is no branch of statistics having any close relation to the agricultural industry that is not more or less adequately represented in the Department's statistical library, as regards the literature of prices it is believed to be the best equipped library in the country, and no reasonable expenditure that may be necessary to maintain its present high standard should be withheld. Its card index to agricultural statistics is also pronounced by visitors who have occasion to consult it to be exceptionally complete and well arranged, and reasonable provision for its continuance is recommended.

#### BUREAU ORGANIZATION.

At the expiration of the fiscal year ended June 30, 1903, the Division of Statistics became a Bureau, and, in anticipation of this change, the Division of Foreign Markets was placed under the direction of the Statistician. Both the clerical and field forces will be materially strengthened, and, while the work must necessarily be continued along practically the same lines as heretofore, no effort will be spared to strengthen and improve the reports on the staple crops and give more detailed information with regard to fruits and various minor crops. Until the present year it was found impossible to make quantitative

estimates of any but the principal crops; but flaxseed was added during the year, and the necessity for extending this work to embrace other products, such as rice, sugar, fruits, etc., is every day being more forcibly brought to the attention of the Department. With a moderate addition to the field force, the agencies for collecting data will be sufficiently well organized to enable the Statistician to include details of all minor crops and of fruits in his monthly reports; but to successfully extend the work to embrace these crops it will be necessary to strengthen the office force by the addition of a sufficient number of compilers to collate and analyze the reports sent in by correspondents and field agents. The organization of the field force has already been carried to a very high state of efficiency, which should be materially increased by the appointment of at least four additional field agents—one in the cotton States, one in the grain States, one for the collection of statistics of rice, and one for garden truck.





## REPORT OF THE CHIEF OF THE DIVISION OF FOREIGN MARKETS.

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U. S. DEPARTMENT OF AGRICULTURE,  
DIVISION OF FOREIGN MARKETS,  
*Washington, D. C., September 1, 1903.*

SIR: I have the honor to submit herewith the report of the Division of Foreign Markets for the fiscal year ended June 30, 1903. The work of the year was initiated and carried on under the official oversight of Mr. Frank H. Hitchcock, chief, until March 31, 1903, when he resigned to become Chief Clerk of the Department of Commerce and Labor. Since that date the efforts of the Division have been confined to carrying on work already in hand.

Respectfully,

GEORGE K. HOLMES, *Chief.*

Hon. JAMES WILSON, *Secretary.*

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### COMPREHENSIVE INVESTIGATIONS OF THE YEAR.

Special comprehensive investigations involving much labor in the collection of statistics and in table building have engaged the efforts of this Division during the fiscal year ended June 30, 1903. These investigations bring together vast amounts of information concerning the trade of this and other countries in exporting and importing farm and forest products which has not hitherto been in form readily available to the general public.

### TARIFFS OF FOREIGN COUNTRIES.

On account of the numerous changes in the tariff laws of many important countries, frequent inquiries have been addressed to this Division for information regarding tariff rates and customs regulations of certain farm products in foreign countries.

In order to supply this information in condensed form, it has been decided to publish a series of bulletins giving in English the import duties on certain important groups of farm products that are levied in foreign countries. By the end of the year a large portion of the work on three of these bulletins had been done, the subject being subdivided into "Meat and meat products," "Fruits and nuts," and "Grain and grain products."

For the purpose of securing this information, the consular officers of the United States in foreign countries were requested to forward to this Department an official copy of the tariff in the country to which they were severally accredited, and in a majority of cases this request

has been cheerfully complied with. Another source of information that has been freely used is the International Customs Journal, published by the International Customs Tariffs Bureau of Brussels, Belgium. The information obtained from these two chief sources has been supplemented by tariff notes appearing in recent numbers of the Board of Trade Journal and Deutsches Handels-Archiv.

#### CONTENTS OF THE THREE TARIFF BULLETINS.

Each bulletin contains two preliminary tables, one on the values of foreign coins and currencies and the other on foreign weights and measures, with their American equivalents.

The greatest care has been exercised to make all information accurate, and no efforts have been spared to get the most recent information for each country. The countries, including their colonies and dependencies, for which these tariff schedules have been compiled number 162, which includes, for the sake of completeness, the tariff of the United States and that of the Philippine Islands.

The bulletin on "Meat and meat products" is intended to give the tariff rates on beef, mutton, pork, etc., in a fresh state, or salted, pickled, smoked, canned, or otherwise prepared, including tongues, sausages, and other meats. Meat products are understood to include lard, tallow, oleo oil, oleomargarine or imitation butter, grease, meat extracts, and similar products.

In the bulletin on "Fruits and nuts" the fruits include the various kinds of fresh or dried fruits, both tropical and nontropical, together with all kinds of fruits, canned, preserved, or otherwise prepared. Nuts comprise those used for food as well as oil nuts.

In the bulletin on "Grain and grain products" the grains comprise barley, buckwheat, corn or maize, maslin, millet, oats, rye, spelt, and wheat; the grain products comprise the various kinds of flour or meal, malt, bread and biscuit, and similar preparations, as well as by-products, such as bran, middlings, and dried brewers' grains.

#### FIFTY YEARS OF FARM EXPORTS.

The numerous demands for information as to export statistics of farm products from the United States, covering a period of years longer than the ten-year statements, as published in Bulletins Nos. 19, 23, and 27 of this Division, suggested the compilation of tables showing farm exports for a long period of years. In view of the fact that the annual issue of the ten-year statements in the form of bulletins was discontinued in 1902, a new publication has been partly prepared entitled "Agricultural exports of the United States, 1851-1902," covering a period of more than half a century, to be completed with several months of work in the following year.

The tables exhibit the values and, when possible, the quantities of farm products exported by the United States for the fiscal years 1851 to 1902, inclusive. The arrangement has been by decades rather than by quinquenniums, as in previous publications, for the obvious reason of the longer period for which the tables were compiled. In addition to the total value and quantity of the articles included in this list, there have been computed the annual average price per unit of quantity, wherever possible, and at the end of each decade the decennial average of quantity and value.



## STRIDES OF HALF A CENTURY.

In 1851 our shipments of farm produce were valued at \$146,714,628, or 82.1 per cent of the total domestic exports, while half a century later, in 1901, they amounted to \$951,628,331, or 65.2 per cent of the total exports. The increase from 1851 to 1901 amounted to \$804,913,703, or nearly 550 per cent. Measured by decades, the aggregate value of farm products exported was \$1,895,637,470 for 1851-1860; \$2,431,023,614 for 1861-1870; \$4,864,406,487 for 1871-1880; \$5,739,513,557 for 1881-1890, and \$7,032,351,921 for 1891-1900.

These figures exhibit a steady and regular increase in the volume of our farm export trade, in which cotton, grain and grain products, and meat and meat products were the principal factors. Other important items were live animals and tobacco.

The five items mentioned have formed the bulk of our farm export shipments throughout the period 1851-1902, with the exception of the years 1861-1865, when, on account of the civil war, our exports of cotton were almost entirely suspended.

From all the data presented, it appears reasonable to assume that under unchanged conditions this increase in the value received for farm products sent abroad will be maintained in the near future.

## TRADE IN FOREST PRODUCTS.

This subject, which had hitherto received no attention, has been made a prominent subject of investigation during the year just closed, and will hereafter receive the attention of this Division in conjunction with the subject of trade in farm products.

## LARGE PROPORTIONS OF TRADE IN FOREST PRODUCTS.

While it is true that in the immense aggregate of our foreign trade forest products occupy a small place relatively, yet, expressed in value, this trade has grown to large proportions, the growth being more especially manifest in exports than in imports. The domestic exports of forest products in 1893 amounted to \$28,127,281; during the five years 1893-1897 the annual average was \$31,782,928, and during the following five years (1898-1902) the annual average grew to \$47,648,530, the highest amount for one year being \$55,369,161 for 1901. This average was exceeded in 1903, when the amount was \$58,281,124. During the eleven years the value of the domestic exports of forest products was about 3 to 4 per cent of the total domestic exports.

During the five years 1893-1897 the annual average value of the imports of forest products was \$44,638,795, an amount from which the imports for each year did not vary much. In the following five years the annual average increased about \$10,000,000, making the average for 1898-1902, \$55,205,996; the highest amount for one year was \$60,633,078 in 1900. In 1903 the value of the imports of forest products rose to the highest figure yet attained, \$71,478,022. The relation between the value of the imports of forest products and the total imports is expressed by 5.9 per cent for the five years 1893-1897, 7.1 per cent for the five years 1898-1902, and 7 per cent for the year 1903.

Previous to 1902 the domestic exports of forest products tended to overtake the imports of these products in value, but the gap between them was widened in 1903 in favor of exports.

#### CLASSES OF FOREST PRODUCTS EXPORTED.

In view of the public concern regarding the destruction of the forests of this country, it becomes desirable to know to what extent, if any, there have been changes in the character of the exports of forest products.

For many years lumber has constituted more than half the value of our domestic exports of forest products, and the percentage has increased slightly during the last eleven years to 54.7 per cent in 1903. This class includes nearly all of the partly manufactured wood. The unmanufactured wood, embraced in the term "timber," has ranged from about 19 to 23 per cent of the total value of domestic exports of forest products during the last eleven years, the percentage for 1903 being 21.9.

While the value of the exported naval stores has been increasing during the last eleven years from about \$7,000,000 to about \$13,000,000 in value, relatively this class of exports has slightly declined, the percentage for the five years 1893-1897 being 24.9, for the five years 1898-1902 being 23.5, and for 1903 being 22.2.

Wood pulp is much more a subject of import than of export, and the smallest amount of exports during the last six years was reached in 1903, its value being \$445,228. Still less than this was the value of the bark and charcoal exported, \$244,904 in 1903, the smallest amount since 1897.

#### FOREST COMPARED WITH FARM.

Comparison may now be made between the domestic exports of forest products with those of farm products as elements in the aggregate of farm and forest products, with analysis of farm products into animal matter and vegetable matter exclusive of forest products.

During the last eleven years the domestic exports of forest products have increased more than those of farm products, although the percentage representing forest products is small, being but 4.9 for the five years 1893-1897, 5.2 for the five years 1898-1902, and 6.2 for 1903.

The domestic exports of animal matter show a relative decline during the eleven years, from 28.1 per cent for 1893-1897, to 25.9 per cent for 1898-1902, and then to 23.6 per cent for 1903.

On the other hand, the domestic exports of vegetable matter, excluding forest products, have relatively increased. They constituted 67 per cent of the total domestic exports of farm and forest products for 1893-1897, 68.9 per cent for 1898-1902, and 70.2 per cent for 1903.

#### CHARACTER OF IMPORTS.

The imports of forest products are constituted chiefly of various gums, india rubber, cork, dyewoods and their extracts, and cabinet woods; also timber, lumber, and wood pulp, principally from Canada.

It appears, then, that the principal portion of these imports is of materials that do not grow in this country, or, if growing here, are

not produced in sufficient quantities for the demands of consumption, as in the case of timber, lumber, and wood pulp.

#### GRAIN AND FLOUR IN THE BRITISH MARKET.

While in England in the spring of 1903, Mr. J. D. Whelpley, of Washington, D. C., at the request of the chief of this Division, made a special investigation of the subject of American grain and flour in the British market, and the results may be published when completed. The report embraced in this bulletin aims to describe the practical handling of grain and flour, the numerous peculiarities and special requirements of the market, and to open to view such aspects of the market as can be found only by an observer and investigator upon the field of the market itself.

#### GERMAN IMPORTS OF FARM PRODUCTS.

Following the lead established by the publication of Bulletin No. 26, concerning the "Agricultural imports of the United Kingdom," most of Bulletin No. 30 has been prepared during the year, analyzing in the same way the imports of farm products by Germany.

Farm products constitute a much larger percentage of the imports of the German Empire than they do in this country, the percentage for Germany being 59.2 for the five calendar years 1897-1901. The average annual value of the farm products imported from 1897 to 1901 was \$745,198,480; the amount for 1901 was \$790,564,700, of which amount the United States supplied 21.9 per cent. Of the imports of agricultural raw materials, the United States supplied 20.5 per cent; food products, 21.7 per cent; feed stuffs, 37.3 per cent; miscellaneous farm products, 3 per cent.

#### RANK OF CONTRIBUTING COUNTRIES.

As contributors to the imports of farm products into Germany, the various countries rank in order as follows, with the percentage of imports derived from each: United States, 21.9 per cent; Russia, excluding Finland, 16.3 per cent; Austria-Hungary, 10.6 per cent; British East Indies, 5.6 per cent; Argentina, 5.4 per cent; Italy, 4.4 per cent; France, 4.4 per cent; the Netherlands, 4 per cent; Brazil, 3.2 per cent; Belgium, 2.8 per cent; United Kingdom, 2.7 per cent; Dutch East Indies, 2.4 per cent; British Australasia, 2.4 per cent; Denmark, 1.6 per cent; Switzerland, 1.6 per cent; Roumania, 1.3 per cent. No other foreign country has a percentage as high as 1.

#### PRODUCTS IN ORDER OF IMPORTANCE.

Upon arranging the various classes of articles of import into Germany in the order of their importance, it is found that by far the leading place is held by grain and grain products, their value for 1901 being \$178,157,500, of which amount 35.3 per cent was derived from the United States, 37.7 per cent from Russia, 11.3 per cent from Austria-Hungary, 6.6 per cent from Argentina, 4.6 per cent from Roumania, and that no other country contributed as much as 1 per cent.

Second in importance is the class of farm imports known as vegetable fibers, the value of which in 1901 was \$101,967,100. The contri-



bution of the United States was 55.7 per cent, mostly in cotton; 75.3 per cent of the total cotton imported came from the United States, the remainder being derived mostly from the British East Indies and Egypt.

Animal fibers are third in importance as a class of imports, but to these the United States contributes substantially nothing.

The class of farm products constituting the class of imports fourth in importance is found in meat and meat products, to which the United States contributed 57 per cent. The principal competitors of this country are Austria-Hungary, the Netherlands, Russia, and Denmark, but the contribution by no one of these countries is as high as 9 per cent.

Sixth in order of importance are live animals, but the United States sent to Germany in 1901 only 0.25 per cent of the imports.

Following in order of importance of import are seeds, 5.7 per cent of the value of which came from the United States; hides and skins, 2.3 per cent; fruits and nuts, 6.1 per cent; coffee, 0.13 per cent; tobacco, 8.2 per cent; all other items of imports of farm products, 8.4 per cent.

#### COMPETITORS IN FRUIT AND TOBACCO.

Of Germany's imports of fresh apples in 1901, 41.3 per cent came from Austria-Hungary, 18.4 from France, 13.3 from Italy, 12.4 from Belgium, 6.0 from the Netherlands, 4.7 from Switzerland, and only 2.4 from the United States.

In the total of the imports of fruits and nuts, Italy takes the lead with 20.7 per cent; British West Africa follows with 16.2 per cent; Austria-Hungary, 10.9 per cent; France, 7.7 per cent; Turkey, 6.6 per cent; the United States, 6.1 per cent, every other country being below the United States.

The United States stands fourth among the principal countries that supply tobacco to Germany, its percentage of the imports of 1901 being 8.2. Germany derives more than half of the imports of tobacco directly from the Dutch East Indies and indirectly about two-thirds; Brazil sends 12.9 per cent.

#### BELGIUM'S FOREIGN TRADE IN FARM PRODUCTS.

Within the limits of Circular No. 26 are embraced condensed statements of the foreign trade of Belgium in leading classes of farm products for the calendar year 1902. The imports of cured meat into that country declined from 31,140,960 pounds in 1900 to 24,847,083 pounds in 1902, and of these amounts the United States contributed 83.9 and 75 per cent, respectively.

Belgium imported 2,299,775 metric tons of cereals in 1902, principally wheat, but with a considerable portion of Indian corn and barley.

#### EXPORTS AND IMPORTS OF THE UNITED STATES.

##### A FARMER'S BALANCE OF TRADE.

It seems not to be generally perceived that this country's favorable balance of trade, which has attracted so much attention during the last decade, is entirely due to the farmer. Were it not for the favorable balance of trade in the products of the farm, the balance would have

been against this country, depending upon the other classes of exports variously embraced in the classes of manufactures, mining, forestry, fisheries, and miscellaneous. During the eleven fiscal years 1893-1903 the excess of domestic exports of farm products over their imports constituted 108 per cent of the excess of total exports, or 8 per cent more than the balance of trade in all products. During the five years 1898-1902 the average annual excess of domestic exports of farm products over their imports amounted to \$481,913,500, and for the preceding five years the annual average was \$224,908,022. In 1903 the excess was \$422,280,126, which would be close to the annual average of the five preceding years were it not for the extraordinarily favorable balance of trade in farm products for 1901, which amounted to \$559,697,280, which was greater than the agricultural balance of any other year in the history of the country by \$14,970,130 over 1898.

The imports of agricultural products for 1903 amounted to \$456,199,325, or \$19,502,268 greater than the highest amount of any preceding year, that of 1892. Of the total imports of 1903, 44.5 per cent are classified as belonging to farm products. This percentage is a declining one—for the five years 1893-1897 it was 51.5 per cent, and for the five years 1898-1902 it was 48.7 per cent.

Farm products have declined as an element of domestic exports also during the last eleven years, although no decline is perceptible during the last five years. In 1903, 63.1 per cent of the total domestic exports were composed of farm products.

#### FARM AND FOREST PRODUCTS COMBINED.

Upon combining the domestic exports of forest products with those of farm products the total constituted 67.3 per cent of all domestic exports for 1903. The percentage for the preceding five years was 68.8. The value of the farm and forest products exported for 1903 was \$936,760,575, compared with which is the annual average of the preceding five years, \$908,686,344, and the average of the five years 1893-1897, \$647,857,875.

These two classes of products constituted 51.4 per cent of the imports of 1903, the percentage for the preceding five years being 55.8 and for the five years 1893-1897, 57.1. In value, the imports of these two classes of products in 1903 amounted to \$527,677,347, in comparison with which is the annual average of the five preceding years, \$434,331,088, and the annual average of the five years 1893-1897, \$33,805,721.

#### CURRENT WORK.

Besides the special reports prepared by this Division there is a large amount of current work growing out of an extensive correspondence with persons in this and foreign countries and growing out of numerous demands made upon the Division by various offices of this Department. This need not be particularized, because the services are small individually, although large in the aggregate. It may be said, however, that the services thus performed for various offices in the Department are a matter of great convenience to them, which they would not find if they were to depend for the information upon collectors outside of the Department.





## REPORT OF THE LIBRARIAN.

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U. S. DEPARTMENT OF AGRICULTURE,  
OFFICE OF THE LIBRARIAN,  
*Washington, D. C., September 26, 1903.*

SIR: I have the honor to submit herewith the executive report of the Library for the fiscal year ended June 30, 1903.

JOSEPHINE A. CLARK,  
*Librarian.*

Hon. JAMES WILSON, *Secretary.*

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### WORK OF THE YEAR.

During the past fiscal year the work of the Library, including the purchasing, cataloguing, and binding of books and publishing bulletins and index cards, has exceeded that of any previous year. The increased appropriation has permitted a larger number of purchases, among the number many especially valuable general and technical works of reference, such as cyclopedias and dictionaries. New scientific periodicals have been added to the list of subscriptions, which list now numbers 625 serial publications.

The reference work in the Library has greatly increased the past year, not only on account of the larger number of workers and the more varied lines of work in the Department, but also on account of the many requests from institutions and individuals, elsewhere, which have been received. These requests have included the loan of books, verification of references, subject lists, translations, and other similar information. The Library has also been able to comply with requests from foreign countries for data not readily obtainable elsewhere.

With the annually increasing facilities for development, the Library extends its usefulness and more nearly keeps pace with the multiplying and varied demands made upon it.

### PERIODICALS.

Every year the list of general agricultural and technical scientific periodicals acquired by purchase and by exchange largely increases. From January to June, inclusive, of the past year 10,113 numbers of the former class of periodicals were received, stamped, recorded, and filed in their places upon the shelves; and of the second class mentioned, 10,062 were similarly cared for. This periodical literature being of first importance in the reference work of the Library, great care is exercised in maintaining complete files, which shall be readily

accessible for use, and the binding of the volumes is kept as nearly up to date as possible to insure their future preservation. The Library is the recipient of a large number of periodicals as gifts and as exchanges, the latter, principally, from learned societies in all parts of the world. The publishers of agricultural papers, with a very few exceptions, continue to forward their papers gratuitously to the Library, and extend numerous courtesies in the direction of supplying extra numbers, so that the files of these papers form a representative collection. These are among the most valuable of the annual accessions, and contribute greatly to the resources of the Library for scientific research. The generous policy of the Department in distributing its publications to institutions and societies at home and abroad, especially to those working along similar lines, materially benefits the Library as to the number and character of exchanges annually received. Frequent requests are received for lists of agricultural papers or technical periodicals devoted to special subjects. Lists of agricultural papers being most frequently desired, a list of such papers received during the year 1902, arranged according to countries and States, has been printed in the Appendix of the Yearbook for 1902. Reprints of this list will be duly available.

#### CATALOGUE.

The sources of increase to the card catalogue during the past year have been from the addition of (1) cards for the current accessions; (2) index cards for the publications of the Department; (3) cards for articles published in certain scientific periodicals and issued by the publishing branch of the American Library Association; (4) cards for certain books in the Library of Congress which are of occasional interest to workers in the Department, and from their accessibility in the Library of Congress are not purchased by this Library; (5) cards for current botanical literature prepared by the New York Botanical Garden. All these publications are most valuable contributions to the catalogue, and are obtained at a minimum cost of both money and time. The growth of the catalogue the past year has necessitated an additional catalogue case with a capacity of 24,000 cards. The catalogue of the Library now contains about 110,000 cards. The preparation of cards for important articles in agricultural periodicals, to which there is constant reference in connection with work in the Department, has been entered upon, and during the coming year the catalogue will be materially enriched by these cards.

#### PRINTED CARDS.

The Library has found it a great advantage to procure all available printed cards which may contribute information relative to the work of the Department. It continues to subscribe, therefore, for several series of printed cards. While the Library has advanced its own work by these means, it has also made it possible for other libraries to obtain from the Library of Congress catalogue cards for publications on agriculture. During the past six months of the fiscal year the copy for current accessions to the Library has been transmitted to the printing division of the Library of Congress for printing upon cards. Extra copies of these cards are available, at a small cost, on application to the Librarian of Congress. These cards may be ordered by simply sending the serial number found in the bulletin of "Accessions to

the Department Library," and catalogue cards containing full descriptions of the books can thus be secured by agricultural college and station libraries at less cost than they could be prepared by each library. Special attention is called to the availability of this particular bibliographical matter relating to agriculture.

#### BINDING.

The preparation of volumes for binding is an important part of the library work, requiring care in collating and accuracy in many details of arrangement to insure satisfactory results. The past year 1,632 volumes have been bound, an increase of nearly 350 as compared with the number bound the year previous. With few exceptions, these volumes were scientific serials, the binding of which is kept as nearly up to date as possible. Additional funds will be available for binding the coming year, which will provide for the binding of a larger number of general works than have hitherto been bound during any one year.

#### PUBLICATIONS AND THEIR DISTRIBUTION.

The quarterly bulletin of accessions to the Library has been issued regularly. This bulletin increases in size with the larger number of additions to the Library. Beginning with Bulletin No. 40, the subject-matter has been classified instead of being arranged alphabetically by authors, a change in arrangement which has proved much more convenient for use of workers in the Department and other specialists. The addition of a serial number to those entries in the bulletin for which cards are printed by the Library of Congress is of assistance to libraries and individuals desiring to purchase cards for these publications. In addition to the distribution of the bulletin for use in the Department, copies are sent to the libraries of the agricultural colleges and experiment stations, to 210 public libraries in the United States, and to a limited number of foreign addresses. As the Library acquires the current agricultural literature and that of allied sciences of this country and of foreign countries as soon as possible after its publication, these bulletins practically furnish a serial bibliography of the subjects.

The printed index cards for the publications of the Department have been issued as usual. An extra number of sets of the cards for the last Yearbook and for the later numbers of the Farmers' Bulletins have been printed to meet the demands from small libraries which have use for these most popular publications of the Department. On account of the wide distribution of the Yearbooks and the Farmers' Bulletins, it is deemed advisable to largely increase the number of sets of cards for these particular publications. In order to defray, in part, the expense of this enlarged distribution of the cards it is proposed that a nominal charge be made for them.

#### INDEXING AGRICULTURAL LITERATURE.

The literature of scientific research is so largely embodied in periodical publications, and the task so hopeless a one for the individual worker to look over all the publications relating to his particular field of investigation, that the need for a comprehensive and consolidated index of this class of literature is becoming more and



more urgent. The Royal Society of London has begun the publication of an "International catalogue of scientific literature," but this publication appears at long intervals, and has not yet furnished references to subjects of special interest to workers in scientific agriculture in the most accessible form for ready reference. Scientists in the agricultural colleges and experiment stations, many of whom are far distant from large collections of books on agriculture and the allied sciences, require information as to the latest results obtained by workers in similar lines of work in all parts of the world, and the Department Library, with its large and up-to-date files of periodicals, is frequently urged to provide this much-needed key to agricultural literature. The indexes already issued by the Department, although confined to its own publications, have been of great service. The card index to the publications of the Department has been especially appreciated, as it has been possible to incorporate the cards at once with the card catalogues in the various libraries. Provision for extending this work to include index cards for general agricultural periodicals which shall be uniform with the cards already distributed has been made, and indexes for "*Landwirtschaftliche Jahrbücher*" and for "*Annales de la science agronomique*" are ready for publication. Periodicals relating to general agriculture which are most frequently consulted, complete sets of which are in the Department Library, will be indexed first. The amount of material to be reviewed is vast, and much of it being of a technical nature, considerable time will be necessary to make appreciable progress in the work with the limited service as yet available for it. In addition to the distribution of the cards to agricultural colleges and experiment stations, provision will be made for the sale of the same to institutions and individuals who may wish to procure them.

#### RELATION OF THE LIBRARY TO AGRICULTURAL COLLEGES AND EXPERIMENT STATIONS.

The Library of the Department, now numbering upward of 80,000 volumes, is more and more frequently called upon and visited each year by professors and students in scientific agriculture, especially those connected with agricultural colleges and experiment stations from distant parts of the country. In many of these institutions the libraries are small and, from lack of funds, fail to furnish the needed information for research work. These institutions can never, nor should they attempt to, purchase certain of the most costly and less frequently used books which are to be found in a large reference library, such as that of the Department. If more adequate provision were made by such institutions for the most necessary current publications, and for their systematic arrangement and cataloguing, the Department Library would, under certain restrictions, furnish the material difficult to obtain in a small library.

The Library has had several requests during the past year for suggestions and aid in organizing or reorganizing agricultural libraries. Assistance of this kind is considered the field work of the Library, of next importance to the immediate service of the Library to the Department and of local cooperation with the libraries of other Departments of the Government. It is hoped that, in the near future, a relationship may exist between this Library and the libraries of agricultural colleges and experiment stations similar to that existing between the Office of Experiment Stations and these State institutions.

**RECOMMENDATIONS.**

The erection of a new building for the Department being now assured, it is earnestly recommended that the great need of suitable accommodations for the Library, both for the preservation of its collections of inestimable value and for the carrying on of its work, be given special consideration. It is urged that this Library, the upbuilding of which has covered an equal number of years with the growth of the Department itself, be placed in a building adapted to its present and future requirements, and at the earliest possible date.

In order that the work of the Library may progress equally with the other lines of work in the Department and meet the demands made upon it, an increased appropriation is necessary. Department laboratories established in Florida and California also depend upon the Library for reference books relative to special investigations, and as these laboratories must be supplied with tools for effective work, I would recommend that the appropriation be increased sufficiently to provide for the placing of necessary reference books in these and other localities where Department work is being done. I would also call attention to the need of larger funds in order to bind a greater number of volumes the coming year. The current literature of science being issued, for the most part, in paper and other equally unsubstantial bindings, much rebinding is a necessity for its preservation. There is a steady gain each year in this line of the Library's work, but means to more nearly meet the requirements in this direction are greatly needed.





## REPORT OF THE APPOINTMENT CLERK.

U. S. DEPARTMENT OF AGRICULTURE,  
OFFICE OF THE APPOINTMENT CLERK,  
*Washington, D. C., October 1, 1903.*

SIR: I have the honor to submit herewith a report respecting the officers, employees, etc., constituting the organized effective force of the U. S. Department of Agriculture as it existed on July 1, 1903, and also various addenda relating to appointments in the several grades and classes in the Department, regulations governing appointments, etc., and length of service of various officers and employees.

Respectfully,

J. B. BENNETT,  
*Appointment Clerk.*

Hon. JAMES WILSON, *Secretary.*

### WORKING FORCE OF THE U. S. DEPARTMENT OF AGRICULTURE ON JULY 1, 1903.

NUMBER OF EMPLOYEES, BY BUREAUS, DIVISIONS, AND OFFICES.

The number of persons on the rolls of the various Bureaus, Divisions, and Offices of the U. S. Department of Agriculture on July 1, 1903, is as follows:

Office of the Secretary of Agriculture .....	65
Weather Bureau .....	1, 410
Bureau of Animal Industry .....	1, 386
Bureau of Plant Industry .....	324
Bureau of Forestry .....	297
Bureau of Statistics .....	137
Bureau of Soils .....	130
Bureau of Chemistry .....	58
Division of Publications .....	154
Office of Experiment Stations .....	106
Division of Entomology .....	34
Division of Biological Survey .....	30
Office of Public Road Inquiries .....	18
Division of Accounts and Disbursements .....	16
Division of Foreign Markets .....	14
Library .....	11
Museum .....	5
Contingent expenses .....	5
Total .....	4, 200

CHANGES IN EMPLOYEES IN THE DEPARTMENT DURING FISCAL YEAR  
ENDED JUNE 30, 1903.

The following shows the changes in the officers and employees in the classified and in the unclassified civil service in the U. S. Department of Agriculture during the fiscal year beginning July 1, 1902, and terminating June 30, 1903:

IN THE UNEXCEPTED CLASSIFIED SERVICE.

Probational appointments.....	434
Absolute appointments at end of probational period.....	271
Transfers to this Department.....	29
Transfers from this Department.....	5
Promotions.....	564
Reductions.....	26
Emergency temporary appointments.....	120
Emergency temporary appointments terminated.....	115
Failures to accept appointment.....	49
Separations by resignation.....	160
Separations by removal.....	72
Separations by death.....	14

IN THE EXCEPTED CLASSIFIED SERVICE.

Appointments to temporary positions excepted from examination and certification in the classified service, including agents, experts, student assistants, assistant forest experts, collaborators, corn and wheat observers, fruit and wheat observers, cotton-region and sugar and rice observers, storm-warning displaymen, and river and rainfall observers.....	1, 206
Separations from temporary positions excepted from examination and certification in the classified service, including agents, experts, student assistants, assistant forest experts, collaborators, corn and wheat observers, fruit and wheat observers, cotton-region and sugar and rice observers, storm-warning displaymen, and river and rainfall observers.....	1, 119

IN THE UNCLASSIFIED SERVICE.

Appointments in unclassified service.....	194
Separations from unclassified service.....	38

VOLUNTARY OBSERVERS AND CORRESPONDENTS.

The following shows the number of voluntary observers and correspondents of the Department:

WEATHER BUREAU.

Voluntary observers in cooperation with the Weather Bureau.....	3, 341
Voluntary crop correspondents in cooperation with the Weather Bureau...	13, 996

BUREAU OF STATISTICS.

County correspondents and their assistants.....	11, 000
State statistical aids.....	9, 000
Township correspondents.....	30, 000
Reports from the above-mentioned correspondents in the Bureau of Statistics are received monthly, supplemented from time to time by the reports of farmers and planters, bankers, merchants, public and private cotton ginneries and the representatives of flour mills and of railroads, the aggregate of all voluntary correspondents in the Bureau of Statistics being, approximately.....	256, 000
Total voluntary observers and correspondents.....	273, 337

## NUMBER OF EMPLOYEES BY SUBDIVISION AND SEX.

On July 1, 1903, the officers and employees on the rolls of the Department, numbering 4,200, consisted of the following:

*Subdivisions of employees.*

Subdivision 1: Executive officers, clerks, editors, messengers, and watchmen.....	668
Subdivision 2: Scientists, scientific investigators, and their assistants .....	1, 927
Subdivision 3: Printers, compositors, pressmen, publication folders and mailers, engineers, firemen, mechanics, workmen, gardeners, skilled laborers, laborers, and charwomen .....	1, 605
Total .....	4, 200

*Sex of employees.*

Females .....	798
Males .....	3, 402
Total .....	4, 200

## STATUS OF CIVIL-SERVICE EMPLOYEES OF THE DEPARTMENT.

The status of the officers and employees in the civil service in the Department on July 1, 1903, as contained in the Official Register of that date, is shown as follows:

*Officers above classification.*

Secretary's office .....	2
Weather Bureau .....	1
Total .....	3

*Number of classified and unclassified positions.*

Bureaus, Offices, and Divisions, etc.	Classified positions not excepted from examination.	Classified positions excepted from examination.	Unclassified positions.	Total.
Office of the Secretary .....	50	2	11	63
Bureau of Forestry .....	67	198	32	297
Bureau of Chemistry .....	40	9	9	58
Bureau of Plant Industry .....	146	59	119	324
Bureau of Soils .....	73	47	10	130
Office Public Road Inquiries .....	4	12	2	18
Bureau of Statistics .....	65	56	16	137
Division of Foreign Markets .....	8	0	6	14
Division of Entomology .....	18	13	3	34
Division of Biological Survey .....	18	11	1	30
Division of Accounts and Disbursements .....	16	0	0	16
Division of Publications .....	36	0	118	154
Library .....	10	0	1	11
Museum .....	1	0	4	5
Office of Experiment Stations .....	45	53	8	106
Contingent fund .....	2	3	0	5
Weather Bureau .....	632	a 750	27	1, 409
Bureau of Animal Industry .....	1, 247	20	119	1, 386
Total .....	2, 477	1, 233	486	4, 200

<sup>a</sup> This number, in the Weather Bureau, includes station agents and student assistants, whose salaries do not exceed \$300 per annum, cotton-region observers, sugar-and-rice-region observers, corn-and-wheat-region observers, fruit-and-wheat-region observers, storm-warning displaymen, special river observers, and special rainfall observers, whose compensation ranges from \$240 per annum to \$16.50 per annum.



## OFFICERS OF THE U. S. DEPARTMENT OF AGRICULTURE.

In the table following is shown the name, State, position, and salary of the officers of the Department July 1, 1903:

*Name, State, position, and salary of officers of Department of Agriculture July 1, 1903.*

Name.	State.	Position.	Salary.
James Wilson .....	Iowa	Secretary .....	\$8,000
Joseph H. Brigham .....	Ohio	Assistant Secretary .....	4,500
Jasper Wilson .....	Iowa	Private secretary to Secretary .....	2,500
Andrew Geddes .....	do	Chief Clerk .....	2,500
Joseph B. Bennett .....	Wisconsin	Appointment Clerk .....	2,000
Cyrus B. Lower .....	Pennsylvania	Chief of Supply Division .....	2,000
Willis L. Moore .....	New York	Chief of Weather Bureau .....	5,000
Henry E. Williams .....	Connecticut	Assistant chief of Weather Bureau .....	3,000
Daniel J. Carroll .....	Dist. of Columbia	Chief clerk of Weather Bureau .....	2,250
Cleveland Abbe .....	New York	Professor of meteorology .....	3,000
Frank H. Bigelow .....	Massachusetts	do .....	3,000
Charles F. Marvin .....	Ohio	do .....	3,000
Daniel E. Salmon .....	North Carolina	Chief of Bureau of Animal Industry .....	4,500
Alonzo D. Melvin .....	Illinois	Assistant chief of Bureau of Animal Industry .....	2,500
Sylvester R. Burch .....	Kansas	Chief clerk of Bureau of Animal Industry .....	2,000
A. M. Farrington .....	New Jersey	Chief of Inspection Division .....	2,500
Henry E. Alvord .....	Virginia	Chief of Dairy Division .....	2,500
John R. Mohler .....	Pennsylvania	Chief of Pathological Division .....	2,500
Emil A. de Schweinitz .....	North Carolina	Chief of Biochemic Division .....	2,500
Marion Dorset .....	Pennsylvania	Assistant in Biochemic Division .....	2,250
Edward B. Jones .....	Indiana	Chief of Quarantine Division .....	2,000
Richard W. Hickman .....	Pennsylvania	Zoologist .....	2,500
Ernest C. Schroeder .....	Maryland	Superintendent of Experiment Stations .....	2,000
Beverley T. Galloway .....	Missouri	Chief of Bureau of Plant Industry .....	4,000
Albert F. Woods .....	Nebraska	Plant pathologist and physiologist in charge .....	3,000
George T. Moore .....	New Hampshire	Plant physiologist and pathologist .....	2,750
Erwin F. Smith .....	Michigan	Pathologist .....	2,750
Herbert J. Webber .....	Missouri	do .....	2,500
Merton B. Waite .....	Illinois	Assistant pathologist .....	2,250
Mark A. Carleton .....	Kansas	Cerealist .....	2,250
James E. Jones .....	Ohio	Chief clerk of Bureau of Plant Industry .....	2,000
Frederick V. Coville .....	New York	Botanist in charge .....	3,000
Lester H. Dewey .....	Michigan	Botanist .....	2,500
Orator F. Cook .....	New York	do .....	2,250
Rodney H. True .....	Massachusetts	Physiologist .....	2,500
Gustavus B. Brackett .....	Iowa	Pomologist in charge .....	3,000
William A. Taylor .....	Michigan	Pomologist .....	2,500
G. Harold Powell .....	Delaware	do .....	2,250
William J. Spillman .....	Washington	Agrostologist .....	3,000
Albert S. Hitchcock .....	Kansas	do .....	2,500
Lee C. Corbett .....	West Virginia	Horticulturist .....	2,500
Adrian J. Pieters .....	Michigan	Botanist .....	2,500
Edward M. Byrnes .....	Maryland	Head gardener .....	1,600
Robert J. Whittleton .....	Illinois	Superintendent of weighing and mailing section, Seed Distribution .....	2,000
James Morrison .....	Iowa	Inspector and superintendent of records, Seed Distribution .....	2,000
Charles F. Saylor .....	do	Special agent and investigator of domestic sugar production .....	p. m. 225
Gifford Pinchot .....	New York	Forester and chief of the Bureau of Forestry .....	3,500
Overton W. Price .....	North Carolina	Assistant forester and assistant chief of the Bureau of Forestry .....	2,500
George P. Sudworth .....	Michigan	Assistant forester .....	2,500
Hermann von Schrenck .....	Missouri	Expert in charge, forest products .....	2,500
William A. Hatt .....	Indiana	Civil engineer .....	2,500
Harvey W. Wiley .....	do	Chemist and chief of the Bureau of Chemistry .....	3,500
Willard D. Bigelow .....	Kansas	Assistant chemist .....	2,500
Logan W. Page .....	Massachusetts	Chief of the road material laboratory .....	2,500
John K. Haywood .....	New York	Chief of the insecticides and agricultural water laboratory .....	2,000
Lyman F. Kebler .....	Pennsylvania	Chief of the drug laboratory .....	2,000
Allerton S. Cushman .....	Connecticut	Chemist, road material laboratory .....	2,000
Milton Whitney .....	Maryland	Soil physicist and chief of the Bureau of Soils .....	3,500
Franklin H. King .....	Wisconsin	Chief of the division of soil management .....	4,000
Frank K. Cameron .....	Maryland	Scientist and soil chemist .....	2,500
Lyman J. Briggs .....	Michigan	Soil physicist .....	2,500
Thomas H. Meaus .....	Dist. of Columbia	Soil scientist .....	2,500
Albert G. Rice .....	Kentucky	Chief clerk of Bureau of Soils .....	2,000
Clarence W. Dorsey .....	Ohio	Soil scientist .....	2,000
John Hyde .....	Nebraska	Statistician and chief of Bureau of Statistics .....	3,500

*Name, State, position, and salary of officers of Department of Agriculture, etc.—Continued.*

Name.	State.	Position.	Salary.
Stephen D. Fessenden .....	Massachusetts ....	Assistant statistician and assistant chief of Bureau of Statistics.	\$2,200
George K. Holmes .....	.....do .....	Chief of the Division of Foreign Markets.	2,500
Frank R. Rutter .....	Maryland .....	Assistant chief of the Division of Foreign Markets.	1,800
Leland O. Howard .....	New York .....	Entomologist and chief of the Division of Entomology.	2,750
Daniel W. Coquillett .....	California .....	Assistant entomologist and assistant chief of the Division of Entomology.	1,800
Charles L. Marlatt .....	Kansas .....	Entomologist in charge of experimental field work.	2,500
Frank H. Chittenden .....	New York .....	Entomologist in charge of breeding experiments.	2,250
Martin Dodge .....	Ohio .....	Director of the Office of Public Road Inquiries.	3,000
Maurice O. Eldridge .....	Tennessee .....	Assistant director of the Office of Public Road Inquiries.	1,800
Alfred C. True .....	Connecticut .....	Director of the Office of Experiment Stations.	3,500
Edwin W. Allen .....	Massachusetts ....	Assistant director of the Office of Experiment Stations.	2,750
Walter H. Beal .....	Virginia .....	Chief of the editorial division, Office of Experiment Stations.	2,500
Walter H. Evans .....	Indiana .....	Chief of division of insular stations, Office of Experiment Stations.	2,250
Wilbur O. Atwater .....	Connecticut .....	Chief of nutrition investigations, Office of Experiment Stations.	2,000
Elwood Meade .....	Wyoming .....	Chief of irrigation investigations.	2,750
John Hamilton .....	Pennsylvania ....	Farmers' institute specialist, Office of Experiment Stations.	2,000
Charles C. Georgeson .....	Kansas .....	Special agent in charge of Alaska experiment station.	3,000
Frank D. Gardner .....	Illinois .....	Special agent in charge of Porto Rico experiment station.	3,000
Jared G. Smith .....	Missouri .....	Special agent in charge of Hawaii experiment station.	3,000
C. Hart Merriam .....	New York .....	Biologist and chief of the Division of Biological Survey.	2,750
Albert K. Fisher .....	.....do .....	Assistant biologist and assistant chief of the Division of Biological Survey.	1,800
Theodore S. Palmer .....	California .....	Assistant in charge of game preservation and introduction, Division of Biological Survey.	2,500
Foster E. L. Beal .....	Massachusetts ....	Economic ornithologist, Division of Biological Survey.	2,500
George W. Hill .....	Minnesota .....	Editor and chief of the Division of Publications.	3,000
Joseph A. Arnold .....	Indiana .....	Associate editor .....	2,000
Benj. D. Stallings .....	Virginia .....	Assistant editor, Division of Publications.	1,800
Robert B. Handy .....	.....do .....	Assistant in charge of document section, Division of Publications.	1,800
Frank L. Evans .....	Pennsylvania ....	Chief of Division of Accounts and Disbursements and Disbursing Clerk.	2,750
Almerico Zappone .....	Dist. of Columbia.	Assistant chief of the Division of Accounts and Disbursements.	2,000
Miss Josephine A. Clark .....	Massachusetts ....	Librarian .....	1,800
Nathaniel Shatswell .....	.....do .....	Caretaker of the Museum .....	1,000

## BOARD OF LABOR EMPLOYMENT.

The board of labor employment, appointed according to the regulations issued by the President July 2, 1902, is constituted as follows: Sylvester R. Burch, chairman; Joseph A. Arnold, vice-chairman; Albert R. Woods; Edgar B. Calvert; R. W. Roberts, secretary.

## DETAIL AND DISTRIBUTION OF CLERKS.

The Revised Statutes of the United States 1878, title 4, section 166, page 27, provides for the distribution of clerks among the various branches of the Department as follows:

Each head of a Department may from time to time alter the distribution among the various Bureaus and Offices of his Department of the clerks allowed by law, as he may find it necessary and proper to do.

## ESTABLISHMENT AND DEVELOPMENT OF THE U. S. DEPARTMENT OF AGRICULTURE.

On September 30, 1861, the Agricultural Division of the Department of the Interior, being the immediate predecessor of the U. S. Department of Agriculture, consisted of nine persons.

The U. S. Department of Agriculture was established on July 1, 1862, by an act of Congress approved May 15, 1862.

The following shows the development of the force of the Department from September 30, 1863, to July 1, 1902:

Date.	Number.	Date.	Number.
1863, September 30 .....	29	1891, July 1 (including Weather	
1867, September 30 .....	99	Bureau, transferred to U. S. De-	
1871, September 30 .....	84	partment of Agriculture on July	
1873, September 30 .....	92	1, 1891) .....	1, 577
1875, September 30 .....	90	1893, July 1 .....	1, 870
1877, September 30 .....	77	1895, July 1 .....	2, 043
1879, June 30 .....	93	1897, July 1 .....	2, 444
1881, July 1 .....	108	1899, July 1 .....	2, 965
1883, July 1 .....	239	1900, November 16 .....	3, 128
1885, July 1 .....	214	1901, July 1 .....	3, 388
1887, July 1 .....	328	1902, July 1 .....	3, 789
1889, July 1 .....	488	1903, July 1 .....	4, 200

## COMMISSIONERS AND SECRETARIES OF AGRICULTURE.

*Name and length of service of each Commissioner and Secretary of Agriculture since the organization of the U. S. Department of Agriculture, July 1, 1862.*

Name.	Rank.	Appointed under the Administration of President—	Date appointed.	Date terminated.
Isaac Newton .....	Commissioner .....	A. Lincoln .....	July 1, 1862	June 19, 1867
John W. Stokes .....	do .....	A. Johnson .....	June 20, 1867	Dec. 4, 1867
Horace Capron .....	do .....	A. Johnson .....	Dec. 5, 1867	July 31, 1871
Frederick Watts .....	do .....	U. S. Grant .....	Aug. 1, 1871	June 30, 1877
Wm. G. Le Duc .....	do .....	R. B. Hayes .....	July 1, 1877	June 30, 1881
Geo. B. Loring .....	do .....	J. A. Garfield .....	July 1, 1881	Apr. 3, 1885
Norman J. Colman .....	do .....	G. Cleveland .....	Apr. 4, 1885	Feb. 12, 1889
Norman J. Colman .....	Secretary .....	G. Cleveland .....	Feb. 13, 1889	Mar. 6, 1889
J. M. Rusk .....	do .....	B. Harrison .....	Mar. 7, 1889	Mar. 6, 1893
J. Sterling Morton .....	do .....	G. Cleveland .....	Mar. 7, 1893	Mar. 5, 1897
James Wilson .....	do .....	Wm. McKinley .....	Mar. 6, 1897	Mar. 5, 1901
James Wilson .....	do .....	Wm. McKinley .....	Mar. 6, 1901	.....



EMPLOYEES IN THE DEPARTMENT WHOSE APPOINTMENT PRECEDES  
JULY 2, 1891.

The table following gives the names of employees on the rolls of the U. S. Department of Agriculture on July 1, 1903, the date of whose appointment precedes July 2, 1891, and the date of the appointment of each, respectively, but not including persons in the Weather Bureau:

*Employees on the rolls of the Department of Agriculture (not including the Weather Bureau) July 1, 1903, whose appointment precedes July 2, 1891.*

[In the "Remarks" column "out" means out of the service of the Department.]

Name.	Date appointed.	Remarks.
Alexander, Sarah C .....	Dec. 30, 1885	
Alexander, William .....	June 20, 1883	
Allen, Edwin W. ....	Aug. 11, 1890	
Alton, D. R. ....	May 8, 1889	
Alvord, Henry E. ....	Nov. 27, 1885	Out from March 31, 1889, to May 11, 1895.
Anthony, Maria .....	Aug. 6, 1888	
Armstrong, Thomas L. ....	June 25, 1889	
Atwater, Wilbur O. ....	Oct. 1, 1888	
Austin, James .....	June 30, 1891	
Adams, Jacob .....	May 11, 1889	Out from June 30, 1893, to April 1, 1898.
Bailey, Vernon .....	May 4, 1887	
Baker, George S. ....	May 28, 1891	
Baker, Lewis R. ....	June 16, 1891	
Ball, Isaac L. ....	July 2, 1888	
Balzer, Emil .....	May 20, 1891	
Banks, Nathan .....	July 1, 1890	Out from June 30, 1892, to December 26, 1896.
Barnard, Mary N. ....	Feb. 27, 1888	
Barnes, Almont .....	Oct. 1, 1868	Out from July 1, 1871, to August 1, 1890; out from November 15, 1893, to April 3, 1896.
Bartholow, Francis A. ....	Dec. 9, 1886	
Beal, Foster E. L. ....	Dec. 6, 1886	
Beal, Walter H. ....	Feb. 27, 1891	
Bell, John A. ....	Oct. 29, 1890	
Bennett, Joseph B. ....	Mar. 10, 1891	
Benton, Frank .....	June 12, 1891	
Berry, Allen L. ....	Aug. 5, 1885	
Bixby, Malvina A. ....	June 16, 1891	
Blankman, Rosie B. ....	May 31, 1884	
Bone, Clark C. ....	Dec. 31, 1890	Out from July 6, 1893, to October 13, 1897.
Bowie, Mary S. ....	Feb. 15, 1887	
Brackett, Gustavus B. ....	Sept. 15, 1890	Out from December 31, 1891, to August 1, 1892; out from May 31, 1893, to August 1, 1896.
Bragdon, Clara K. ....	Dec. 5, 1885	
Bradford, Virginia P. ....	Oct. 1, 1885	Out from February 25, 1892, to April 2, 1900.
Breedin, Louise .....	Oct. 4, 1881	
Brister, Henry .....	July 25, 1889	
Brooks, Alex. H. ....	Nov. 15, 1889	
Burke, Edmund .....	Apr. 15, 1869	
Burke, Laura D. ....	June 16, 1891	
Bruser, Joseph .....	Dec. 4, 1890	
Bullard, L. L. ....	Nov. 19, 1890	
Burr, M. Helen .....	Jan. 3, 1882	
Canatsey, William S. ....	Dec. 30, 1889	Out from June 13, 1893, to May 22, 1897.
Carleton, Mark A. ....	Apr. 8, 1891	
Carter, George .....	Jan. 1, 1887	
Cathcart, Ellen W. ....	Oct. 31, 1889	
Champney, Mary G. ....	Sept. 14, 1881	
Chittenden, Frank H. ....	Apr. 23, 1891	
Clark, Charles B. ....	Nov. 9, 1887	
Clark, Emma L. ....	Aug. 16, 1882	
Clark, Thomas G. ....	June 15, 1891	
Clark, William D. ....	do.	
Clifton, Richard S. ....	Nov. 19, 1890	
Colbath, Mary F. ....	Apr. 18, 1889	
Colman, Marie A. S. ....	May 2, 1885	
Cook, Richard H. ....	Feb. 1, 1864	Out from July 15, 1893, to August 26, 1896.
Cooney, Florence C. ....	Apr. 1, 1888	
Coquillet, Daniel W. ....	June 29, 1887	
Corsa, William P. ....	Sept. 17, 1890	
Coville, Frederick V. ....	July 5, 1888	
Cox, Frances C. ....	July 18, 1883	
Coyle, Thomas .....	Jan. 15, 1888	
Crain, Anna C. ....	Oct. 20, 1886	
Crompton, Harry .....	July 1, 1891	
Cumming, David .....	Mar. 26, 1891	

*Employees on the rolls of the Department of Agriculture (not including the Weather Bureau), July 1, 1903, whose appointment precedes July 2, 1891—Continued.*

Name.	Date appointed.	Remarks.
Dean, Albert.....	Mar. 29, 1890	
Dent, Mary T.....	Apr. 2, 1887	
de Schweinitz, Emil A.....	Aug. 23, 1888	
Dewey, Lyster H.....	Aug. 27, 1890	
Disney, Richard H.....	Apr. 1, 1882	
Dodge, Allen.....	Aug. 1, 1881	Out from July 7, 1895, to July 1, 1896.
Dorsett, Palemon H.....	Feb. 19, 1891	
Du Bois, Carrie L.....	May 7, 1883	
Edwards, Ella.....	May 1, 1882	
Emery, Mary E.....	July 1, 1889	
Evans, Frank L.....	July 1, 1875	
Fairfax, Thaddeus.....	Dec. 3, 1885	
Fairchild, David G.....	July 25, 1889	
Farrington, Arthur M.....	Aug. 1, 1884	
Faville, George C.....	Apr. 21, 1887	
Fealy, Nellie E.....	Dec. 16, 1889	
Ferguson, George R.....	June 23, 1890	
Finckel, Charlotte B.....	June 1, 1882	
Fisher, Albert K.....	July 1, 1885	
Flannery, James.....	Dec. 18, 1890	
Foley, William.....	Mar. 6, 1890	
Forbes, John.....	May 28, 1891	
Frost, Lorenzo D.....	Jan. 6, 1890	Out from March 8, 1893, to May 21, 1897.
Gallagher, Lawrence.....	Jan. —, 1879	
Galloway, Beverly T.....	Aug. 24, 1887	
Gardner, Helen.....	Jan. 1, 1885	
Gardner, Julia.....	Oct. 1, 1886	
Gantt, John E. M.....	Mar. 21, 1889	
Garlick, William B.....	June 3, 1891	
Gelletly, Celia.....	Sept. 19, 1890	
Gerrish, James L.....	June 15, 1891	
Gilmore, Elias.....	June 30, 1891	
Goodchild, Martha A.....	July 1, 1884	
Granger, Dighton.....	Nov. 18, 1890	Out from August 15, 1893, to October 13, 1897.
Gregory, Fannie N.....	July 15, 1882	
Haines, William S. D.....	Dec. 19, 1888	
Halley, James.....	July 1, 1862	
Halley, William.....	Oct. 15, 1868	Out from May 13, 1885, to January 31, 1891.
Harpst, William.....	Dec. 11, 1890	
Harrison, Carrie.....	Aug. 23, 1887	Out from September 30, 1894, to January 1, 1898.
Harrison, Louise T.....	Aug. 8, 1887	
Harrison, Thomas B.....	July 1, 1891	Out from July 25, 1893, to April 14, 1897.
Hart, John E.....	June 30, 1891	
Harvey, John A.....	Aug. 1, 1878	
Hassall, Albert.....	May 24, 1887	Out from April 24, 1890, to March 7, 1891.
Hauser, Ernest.....	June 30, 1879	
Havey, Tessie C.....	June 16, 1891	
Hawkins, Alfred.....	Apr. 24, 1889	
Hayden, James A.....	Dec. 17, 1890	Out from March 31, 1895, to January 17, 1898.
Heidemann, Otto.....	June 1, 1883	
Henkel, Alice.....	July 26, 1889	Out from January 30, 1894, to August 3, 1898.
Hickman, Richard W.....	Mar. 31, 1888	
Hill, George William.....	Oct. 1, 1888	
Hill, Harry L.....	Mar. 10, 1891	Out from February 17, 1893, to July 7, 1898.
Howard, Leland O.....	Nov. 15, 1878	
Huddleson, Sarah M.....	Sept. 30, 1889	
Huelson, Julius.....	Mar. 10, 1888	
Humphrey, William E.....	Sept. 24, 1880	
Ingram, Martha M.....	June 15, 1882	
Irwin, James.....	Mar. 19, 1890	Out from July 5, 1893, to April 15, 1897.
Irwin, William N.....	Apr. 1, 1891	
Jenkins, Sarah E.....	Nov. 15, 1881	
Jerome, Hiram.....	Oct. 4, 1889	
Johnson, Maria.....	Aug. 23, 1887	
Johnson, Martin A.....	June 27, 1883	Out from July 3, 1885, to September 27, 1886.
Johnston, Carrie E.....	Sept. 30, 1889	
Jones, Edward B.....	Mar. 5, 1884	
Jorden, William D.....	Apr. 20, 1891	
Keleher, Thomas A.....	Jan. —, 1884	
Kerr, James K.....	July 1, 1862	
King, George E.....	Jan. 1, 1875	
King, Odie A.....	Nov. 16, 1889	Out from November 3, 1893, to May 29, 1900.
King, William M.....	June 30, 1885	Out from November 30, 1893, to April 21, 1897.
Kochanowski, Reinhard.....	June 16, 1891	
Latham, Ella G.....	Feb. 12, 1883	
Love, Amelia H.....	May 7, 1882	Out from September 10, 1894, to April 29, 1897.
Luce, E. B.....	June 15, 1891	
Luebker, Otto.....	June 30, 1891	
Lyons, Evelyn.....	Sept. 1, 1882	
Mahon, Martha H.....	Sept. 2, 1885	
Marlatt, Charles L.....	Dec. 1, 1888	
Marshall, Mary G.....	June 15, 1888	

*Employees on the rolls of the Department of Agriculture (not including the Weather Bureau) July 1, 1903, whose appointment precedes July 2, 1891—Continued.*

Name.	Date appointed.	Remarks.
Masius, Alfred G. ....	July 30, 1890	
Melvin, Alonzo D. ....	Dec. 10, 1886	
Merriam, C. Hart .....	July 1, 1885	
Miller, Sallie E. ....	June 15, 1888	
Miller, Virginia .....	July 1, 1879	
Montgomery, Anna .....	July 18, 1883	
Montgomery, Mary C. ....	Dec. 30, 1890	
Morrison, Ada B. ....	Oct. 1, 1886	
Murphy, James A. ....	June 15, 1891	
McCutchen, Marguerite .....	July 1, 1884	
McEnaney, Joseph P. ....	Dec. 20, 1890	
Nelson, Edward W. ....	Oct. 27, 1890	
Nelson, William .....	July 23, 1890	Out from May 4, 1894, to January 17, 1898.
Nichols, Indiana J. ....	May 1, 1889	
O'Donoghue, Clara .....	Apr. 13, 1887	
Olden, John W. ....	June 30, 1889	
Oshel, Thomas W. ....	July 15, 1890	
Paine, Phelps .....	June 27, 1891	Out from May 3, 1893, to May 22, 1897.
Palmer, Theodore S. ....	Apr. 1, 1889	
Parker, Annie .....	May 2, 1887	
Pergande, Theodore .....	June 30, 1879	
Perry, James M. ....	June 30, 1883	
Peters, Edward T. ....	Oct. 13, 1883	
Phillips, William L. ....	June 30, 1885	
Pierce, Newton B. ....	May 7, 1889	
Proudfoot, William .....	June 23, 1891	
Quinn, Eva H. ....	Sept. 1, 1882	Out from October 13, 1893, to May 10, 1897.
Quirk, Michael J. ....	Nov. 22, 1890	
Ray, Thomas J. ....	Mar. 15, 1865	
Reese, Robert M. ....	Dec. 19, 1890	
Riggles, Thomas .....	July 1, 1882	
Riley, Sarah A. ....	Feb. 1, 1891	
Rose, W. H. ....	July 16, 1884	
Roth, Filibert .....	Oct. 1, 1888	Out from August 5, 1898, to June 1, 1900; out from November 15, 1901, to February 7, 1903.
Rothrock, Leulah .....	June 27, 1887	
Russell, Fremont L. ....	Jan. 1, 1891	
Rutledge, Thomas .....	Dec. 19, 1881	Out from March 15, 1894, to March 30, 1897.
Ryder, James F. ....	Apr. 17, 1888	
Safford, Mary F. ....	Dec. 10, 1883	
Salmon, Daniel E. ....	July 1, 1881	
Saunders, Belle C. ....	June 30, 1889	
Scanlon, Patrick .....	Apr. 1, 1868	
Schmidt, Flora .....	June 15, 1883	
Schroeder, Ernest C. ....	Aug. 15, 1887	
Schroeder, Frank .....	May 28, 1891	
Schwarz, Eugene A. ....	Nov. 15, 1878	
Seaton, Charles H. ....	Feb. 28, 1891	
Seaton, Sarah F. ....	June 20, 1883	Out from October 15, 1893, to June 16, 1897.
Shanahan, Mary E. ....	Oct. 18, 1887	
Shatswell, Nathaniel .....	May 20, 1891	Out from October 15, 1893, to June 16, 1897.
Shimoneck, William C. ....	Apr. 7, 1890	Out from December 31, 1893, to April 3, 1897.
Sine, John B. ....	Apr. 20, 1891	
Smith, Erwin F. ....	Sept. 20, 1886	
Smith, Lydia J. ....	Mar. 5, 1885	
Smith, Robert E. ....	Oct. 1, 1866	
Sommers, Sarah L. ....	Dec. 12, 1879	
Spencer, Guilford L. ....	July 12, 1883	Out from September 24, 1894, to February 13, 1895.
Steineger, Thora .....	Feb. 1, 1888	
Stevens, Ernestine H. ....	Sept. 25, 1877	Out from March 31, 1896, to March 17, 1897.
Stewart, Sescio .....	Apr. 13, 1891	
Stoddart, Mary C. ....	Sept. 1, 1884	
Stone, Israel W. ....	June 5, 1889	Out from June 29, 1894, to March 20, 1896.
Sudworth, George B. ....	Aug. 31, 1886	Out from July 22, 1898, to March 16, 1899.
Sullivan, Mary .....	Nov. 1, 1884	
Swingle, Walter T. ....	Mar. 30, 1891	
Tabler, John H. S. ....	July 20, 1888	
Taylor, William A. ....	Feb. 24, 1891	
Thomas, Charlotte R. ....	Feb. 7, 1889	Out from October 15, 1893, to August 9, 1897.
Thorn, Margaret E. ....	Jan. 9, 1888	
Tidd, Mary S. ....	Apr. 1, 1888	
Tourtellotte, S. H. ....	June 15, 1891	Out from April 18, 1893, to January 5, 1898.
Tracy, Samuel M. ....	July 1, 1891	
Trescott, Thomas C. ....	Dec. 1, 1881	
Trice, Taylor .....	July 1, 1889	
True, Alfred C. ....	Mar. 2, 1889	
Vining, Harriet L. ....	Sept. 29, 1885	
Waite, Merton B. ....	Nov. 1, 1888	
Walden, Celena .....	Aug. 5, 1881	
Walter, Henry S. ....	June 30, 1883	
Ward, George W. ....	Mar. 9, 1891	
Wharton, Virginia K. ....	Oct. 2, 1882	Out from November 2, 1895, to November 21, 1896.



*Employees on the rolls of the Department of Agriculture (not including the Weather Bureau) July 1, 1903, whose appointment precedes July 2, 1891—Continued.*

Name.	Date appointed.	Remarks.
Whitney, Joseph C .....	Nov. 22, 1890	Out from March 31, 1893, to July 1, 1897.
Whittleton, Robert J .....	July 1, 1889	
Wight, John C .....	July 1, 1884	
Wilcox, Della E .....	July 1, 1891	
Wiley, Harvey W .....	Apr. 9, 1883	Out from July 28, 1894, to October 16, 1894.
Williams, Joseph .....	May 21, 1883	
Williams, Louis S .....	Aug. 20, 1890	
Winfield, Alice M .....	Sept. 1, 1882	
Wood, Maria L .....	Dec. 1, 1881	Out from April 24, 1882, to August 1, 1882. Out from May 9, 1885, to August 1, 1885; out from June 30, 1886, to August 27, 1886; out from March 31, 1888, to August 1, 1890.
Wray, W. H .....	July 16, 1884	
Wright, Annette M .....	July 16, 1889	
Yerby, Everett D .....	Sept. 7, 1882	
Zappone, Almerico .....	do.	
Zimmerman, Marguerite B ..	July 16, 1890	
Zuendell, Theodore B .....	June 16, 1891	

WEATHER BUREAU EMPLOYEES WHOSE APPOINTMENT PRECEDES JULY 2, 1891.

The following gives the names of employees in the Weather Bureau of the United States Department of Agriculture on July 1, 1903, the date of whose appointment precedes July 2, 1891. The persons constituting the Weather Bureau were transferred to the United States Department of Agriculture from the United States Army on July 1, 1891, previous to which date they were in the Signal Corps of the United States Army. The Weather Bureau was created by "An act to increase the efficiency and reduce the expenses of the Signal Corps of the Army, and to transfer the Weather Service to the Department of Agriculture," approved October 1, 1890.

*Employees in the Weather Bureau July 1, 1903, whose appointment precedes July 2, 1891.*

[In the "Remarks" column "out" means out of the service of the Department.]

Name.	Date appointed.	Remarks.
Abbe, Cleveland .....	Jan. 3, 1871	Out from January 21, 1877, to March 16, 1881.
Allen, George .....	Jan. 20, 1872	
Allen, Robert G .....	Oct. 18, 1887	
Ashton, Clinton J .....	Oct. 25, 1881	
Ashton, John C .....	June 14, 1878	Out from December 18, 1890, to May 12, 1891.
Adie, Charles .....	Mar. 18, 1889	
Alciatore, Henry F .....	Dec. 1, 1886	
Ashenberger, Albert .....	Nov. 8, 1889	
Beall, Samuel W .....	Sept. 25, 1871	Out from September 21, 1888, to October 11, 1889.
Bennett, Maitland C .....	July 13, 1883	
Berry, James .....	July 8, 1878	
Berry, William .....	Apr. 27, 1877	
Blundon, Benjamin A .....	Mar. 5, 1878	Out from July 1, 1894, to June 30, 1898; out from November 18, 1898, to December 7, 1898.
Brandenburg, Frederick H ..	Aug. 21, 1877	
Branham, Edward A .....	Apr. 1, 1873	
Brown, Edward A .....	Sept. 5, 1887	
Bacon, Samuel, Jr. ....	Mar. 8, 1890	Out from January 7, 1890, to May 31, 1891.
Bailey, Wayland .....	Aug. 9, 1884	
Baldwin, Harrison McP .....	June 3, 1881	
Barry, James A .....	June 22, 1878	
Barwick, James A .....	Mar. 31, 1873	Out from January 7, 1890, to May 31, 1891.
Bate, Henry C .....	Sept. 16, 1886	
Bauer, Jacob W .....	July 23, 1883	
Beahan, Frank R .....	July 26, 1887	
Bell, William .....	June 4, 1880	Out from January 7, 1890, to May 31, 1891.
Blagden, John D .....	Feb. 13, 1888	
Blandford, Samuel M .....	Oct. 15, 1887	
Blystone, Montello E .....	Jan. 25, 1890	
Blythe, William T .....	Feb. 9, 1870	Out from January 7, 1890, to May 31, 1891.
Bolton, Joseph P .....	May 7, 1885	
Boyer, Harry B .....	May 26, 1881	
Bradley, James A .....	June 26, 1891	
Brand, Albert .....	Aug. 6, 1889	Out from January 7, 1890, to May 31, 1891.
Bridges, Theodore L .....	June 4, 1888	
Bronson, Byron H .....	Nov. 1, 1883	

*Employees in the Weather Bureau July 1, 1903, whose appointment precedes July 2, 1891—Continued.*

Name.	Date appointed.	Remarks.
Buell, Allen .....	Sept. 16, 1870	Out from April 21, 1878, to August 12, 1878; out from July 9, 1898, to April 30, 1899.
Burns, Alexander G .....	Sept. 20, 1887	Out from September 2, 1883, to November 23, 1883.
Byram, John W. ....	Sept. 2, 1878	
Calvert, Edgar B. ....	Mar. 21, 1890	
Carroll, Daniel J. ....	Mar. 3, 1879	
Chapman, Mattie H. ....	Nov. 14, 1888	
Cavanagh, William C. ....	July 1, 1891	
Cover, Louis C. ....	do.	
Conway, Margaret E. ....	do.	
Church, John P. ....	Feb. 25, 1882	
Claveloux, Francis A. ....	July 9, 1878	
Cleaver, Frank M. ....	Aug. 7, 1878	Out from July 2 <sup>d</sup> , 1878, to May 19, 1879.
Cline, Isaac M. ....	July 7, 1882	
Cox, Henry J. ....	Aug. 1, 1884	
Carpenter, Ford A. ....	Feb. 2, 1888	
Chaffee, Frank P. ....	Mar. 1, 1879	
Chappel, George M. ....	Mar. 30, 1881	
Clarke, Frederick H. ....	Mar. 3, 1879	
Collins, Thomas S. ....	Sept. 4, 1872	
Conger, Norman B. ....	Aug. 28, 1878	
Connell, Maurice ....	Dec. 9, 1884	
Connor, Patrick ....	Mar. 4, 1876	Out from November 18, 1876, to February 28, 1879; out from June 6, 1889, to January 20, 1890.
Conrad, Frederick W. ....	Nov. 10, 1871	
Considine, Thomas J. ....	Nov. 1, 1888	
Craig, John .....	Oct. 20, 1873	
Crawford, Thomas. ....	Apr. 30, 1890	
Cronk, Corydon P. ....	July 7, 1882	
Cronk, James W. ....	Oct. 10, 1887	
Crosby, Arthur W. ....	Dec. 27, 1890	
Currier, William S. ....	Aug. 2, 1887	
Cuthbertson, David ....	Nov. 16, 1872	
Davis, Albert J. ....	Apr. 20, 1881	Out from July 31, 1893, to September 27, 1897.
Day, Preston C. ....	June 29, 1888	
de Grain, Reinhold F. ....	July 24, 1874	
Diehl, Genevra B. ....	July 1, 1887	
Dillon, Edward. ....	Oct. 22, 1881	
Davis, William ....	June 2, 1877	
Day, Walcott L. ....	Oct. 20, 1883	
Demain, Edward R. ....	July 17, 1880	
Denson, Lee A. ....	Apr. 9, 1888	
Dey, Luther M., sr. ....	Nov. 20, 1874	
Dey, Luther M., jr. ....	Nov. 1, 1890	Out from October 6, 1885, to September 22, 1886; out from October 20, 1889, to March 25, 1890.
Dick, Harvey B. ....	Mar. 18, 1886	
Doherty, Cornelius J. ....	Oct. 14, 1889	
Donaldson, William E. ....	Jan. 30, 1890	
Dorman, Louis ....	Oct. 6, 1880	
Dosher, Samuel L. ....	May 11, 1883	
Dudley, William M. ....	Aug. 9, 1890	
Duff, Fenton H. ....	Aug. 5, 1890	
Easton, Edward C. ....	Feb. 16, 1889	
Eddey, George W. ....	Jan. 15, 1887	
Eddy, Nathan S. ....	Oct. 5, 1875	Out from May 12, 1885, to October 31, 1890. Out from January 1, 1884, to March 11, 1884.
Emery, Eben H. ....	July 30, 1884	
Emery, Samuel C. ....	Apr. 9, 1873	
Evans, Edward A. ....	Dec. 16, 1879	
Farish, Franck ....	Nov. 16, 1883	
Farrington, William H. ....	Aug. 2, 1875	
Foy, John T. ....	July 8, 1878	
Fraber, John W. ....	Feb. 9, 1870	
Frankenfield, Harry C. ....	Jan. 4, 1882	
Fallon, William H. ....	Sept. 8, 1880	
Fassig, Oliver L. ....	Jan. 12, 1883	Out from August 5, 1882, to August 31, 1882; out from January 1, 1883, to July 2, 1883.
Felger, George W. ....	Sept. 4, 1874	
Fisher, David. ....	Nov. 30, 1880	
Fitzgerald, John. ....	May 20, 1874	
Franklin, George E. ....	July 5, 1878	
Frederick, Julius R. ....	Aug. 1, 1884	
Garriott, Edward B. ....	May 18, 1874	
Gillam, Frank. ....	Aug. 17, 1880	
Gaston, Belle ....	June 21, 1882	
Green, William B. ....	May 29, 1889	Out from February 1, 1885, to August 31, 1882; out from August 13, 1893, to January 11, 1899.
Gardiner, I. Gwynn ....	May 19, 1885	
Goddings, Richard M. ....	July 29, 1881	
Glass, Elvin J. ....	Jan. 20, 1882	
Gibson, Thomas. ....	May 16, 1874	
Glenn, Samuel W. ....	Oct. 1, 1877	
Gosewisch, Frederic Z. ....	Feb. 29, 1872	
		Out from January 16, 1881, to October 31, 1881.

*Employees in the Weather Bureau July 1, 1903, whose appointment precedes July 2, 1891—Continued.*

Name.	Date appointed.	Remarks.
Goucher, Henry.....	Jan. 15, 1886	
Grant, Robert Q.....	July 23, 1888	
Grasse, Herchmer W.....	Dec. 24, 1890	Out from September 17, 1891, to November 15, 1891.
Gray, James J.....	Nov. 20, 1885	
Gresham, Samuel P.....	Nov. 24, 1887	
Grimes, George E.....	Jan. 22, 1887	
Grover, John.....	Mar. 13, 1880	
Hay, George W.....	Dec. 4, 1874	
Hayes, Michael.....	Oct. 27, 1880	
Harkness, Robert B.....	July 1, 1891	
Hoagland, Annie E.....	Apr. 29, 1889	
Heiskell, Henry L.....	June 9, 1877	
Henry, Alfred J.....	July 12, 1878	
Hercus, Alice T.....	Jan. 3, 1887	
Holmes, Charles.....	Oct. 3, 1878	Out from November 16, 1899, to July 15, 1900.
Hotze, Ruby S.....	Oct. 18, 1890	
Hunt, George E.....	Jan. 27, 1882	Out from August 22, 1885, to April 25, 1888.
Husson, William M.....	Aug. 5, 1890	
Hackett, Arthur E.....	July 9, 1889	
Hardin, Hal P.....	Dec. 28, 1886	
Hardinge, Robert M.....	July 2, 1885	
Hass-Hagen, George.....	Jan. 7, 1878	
Hayden, Julius C.....	Dec. 31, 1889	
Hazen, John S.....	Aug. 17, 1889	
Heck, George J.....	Jan. 12, 1882	
Hersey, Henry B.....	June 29, 1883	
Hobbs, Everett C.....	May 2, 1885	
Howe, Henry C.....	July 29, 1890	
Hyatt, Robert J.....	Aug. 27, 1880	Out from September 16, 1888, to January 20, 1889.
Johnson, Enoch G.....	July 17, 1882	
Jones, Edward P.....	Oct. 11, 1883	
Jones, John H.....	May 8, 1879	
Jennings, Thorp B.....	Oct. 20, 1871	
Jesunofsky, Lewis N.....	Jan. 21, 1875	
Judkins, Levi A.....	Mar. 10, 1890	
Keller, David.....	Jan. 31, 1890	
Keough, William.....	Feb. 1, 1873	
Kimball, Herbert H.....	July 30, 1884	
King, Thomas H.....	Aug. 1, 1882	Out from August 9, 1895, to July 6, 1896.
Kinnear, Aaron H.....	May 18, 1874	
Kelliher, John J.....	Apr. 26, 1890	
Kenealy, James.....	June 24, 1876	
Lamont, John C.....	July 25, 1872	
Larcombe, Benjamin F.....	Sept. 29, 1883	
Lazenby, Richard O.....	May 27, 1886	
Lane, Nathan D.....	Aug. 11, 1871	Out from August 11, 1876, to February 28, 1879.
Lawton, George E.....	May 2, 1885	
Ling, Charles W.....	Aug. 27, 1884	Out from July 17, 1888, to February 3, 1889.
Linney, Charles E.....	Apr. 22, 1890	
Linsley, Julius G.....	Feb. 1, 1878	
Long, Francis.....	Aug. 1, 1884	
Loveland, George A.....	July 6, 1882	
Lyon, Horace F.....	Mar. 18, 1890	
McAdie, Alexander G.....	Jan. 4, 1882	Out from June 12, 1888, to December 11, 1890.
McDermott, Edward.....	May 2, 1871	Out from April 16, 1894, to April 4, 1897.
Marean, Delzene.....	Aug. 25, 1890	
Maring, Delos T.....	Jan. 16, 1884	
Marvin, Charles F.....	Sept. 1, 1884	
Mattison, Edward M.....	Dec. 25, 1874	Out from June 8, 1876, to November 13, 1878.
Melton, James H.....	Feb. 1, 1878	
Meston, Robert D.....	Mar. 5, 1872	
Monroe, Joseph U.....	June 16, 1891	
Moore, Theodore T.....	July 3, 1878	
Moore, Willis L.....	Apr. 21, 1876	
McCallum, Daniel P.....	Sept. 20, 1890	
McDonough, Patrick.....	Dec. 27, 1886	
McGann, Edward W.....	Feb. 29, 1872	
McGuinness, William C.....	Jan. 2, 1890	
McLean, John J.....	Dec. 15, 1877	
McNally, Henry A.....	Oct. 17, 1887	
Marbury, John B.....	Dec. 16, 1879	
Maxwell, William D.....	July 10, 1878	
Mitchell, Alexander J.....	Jan. 3, 1882	
Mosby, Samuel L.....	Nov. 1, 1887	
Murdoch, Lester H.....	May 21, 1891	
Murphy, Daniel C.....	Nov. 9, 1871	Out from November 10, 1876, to January 10, 1877.
Neifert, William W.....	Nov. 27, 1885	
Newman, Fitzhugh.....	Apr. 9, 1881	
Newson, John F.....	Apr. 8, 1891	
Norrington, William.....	Mar. 17, 1875	Out from March 17, 1885, to July 20, 1887.
Nunn, Roscoe.....	July 1, 1891	
O'Neill, Daniel F.....	Dec. 13, 1887	
O'Connor, Gerald J.....	Jan. 2, 1890	Out from August 22, 1898, to January 22, 1899.
O'Donnell, John J.....	Oct. 18, 1886	Out from September 1, 1891, to June 9, 1892.



*Employees in the Weather Bureau July 1, 1903, whose appointment precedes July 2, 1891—Continued.*

Name.	Date appointed.	Remarks.
Olds, William J. ....	Jan. 20, 1885	Out from August 12, 1886, to January 10, 1887; out from August 1, 1893, to July 31, 1895.
Patrick, William .....	Aug. —, 1871	
Pennywitt, Henry .....	Feb. 17, 1874	Out from August 6, 1876, to March 4, 1880.
Peticolas, Virginia M. ....	Sept. 16, 1887	Out from September 27, 1874, to January 6, 1875; out from August 1, 1890, to June 15, 1891; out from April 6, 1893, to February 29, 1896.
Penrod, Hiram J. ....	Mar. 4, 1871	
Phillips, William F. R. ....	July 6, 1883	Out from March 1, 1883, to December 5, 1883.
Plummer, William .....	Feb. 1, 1883	
Porter, William D. ....	Nov. 14, 1889	Out from January 25, 1884, to October 8, 1884.
Potter, Samuel A. ....	Feb. 11, 1888	
Pugh, Thomas O. ....	Dec. 8, 1881	Out from January 25, 1884, to October 8, 1884.
Passailaigue, Louis F. ....	July 10, 1883	
Patrick, Henry R. ....	Jan. 5, 1886	Out from January 25, 1884, to October 8, 1884.
Piercy, Joseph C. ....	Oct. 14, 1880	
Pindell, Lewis M. ....	May 18, 1878	Out from January 25, 1884, to October 8, 1884.
Pursell, Ulysses G. ....	July 9, 1885	
Robinson, Jesse H. ....	Mar. 6, 1872	Out from January 25, 1884, to October 8, 1884.
Randolph, Frederick J. ....	Jan. 6, 1879	
Reeder, George .....	Dec. 16, 1885	Out from January 25, 1884, to October 8, 1884.
Richards, Edward B. ....	Mar. 13, 1888	
Richardson, Charles H. ....	Nov. 1, 1890	Out from January 25, 1884, to October 8, 1884.
Richardson, Herbert W. ....	Jan. 19, 1886	
Ridgway, Frank .....	Jan. 25, 1879	Out from January 25, 1884, to October 8, 1884.
Roche, Henry H. ....	Dec. 24, 1886	
Ryker, John N. ....	July 7, 1882	Out from January 25, 1884, to October 8, 1884.
Seyboth, Robert .....	Oct. 21, 1870	
Smith, George W. ....	July 8, 1878	Out from January 25, 1884, to October 8, 1884.
Smith, Herman W. ....	Oct. 21, 1887	
Smith, Horace E. ....	July 1, 1891	Out from January 25, 1884, to October 8, 1884.
Smith, John W. ....	June 12, 1874	
Smith, J. Warren .....	Oct. 6, 1888	Out from January 25, 1884, to October 8, 1884.
Smyth, Patrick H. ....	Sept. 4, 1888	
Spencer, Belle P. N. ....	July 1, 1883	Out from January 25, 1884, to October 8, 1884.
Stewart, John C. ....	Apr. 2, 1881	
Sullivan, John .....	Jan. 22, 1882	Out from January 25, 1884, to October 8, 1884.
Salisbury, George N. ....	July 3, 1883	
Schaeffer, John W. ....	Oct. 24, 1887	Out from January 25, 1884, to October 8, 1884.
Schneider, Charles F. ....	Dec. 28, 1885	
Scholl, Walter H. ....	Nov. 22, 1887	Out from January 25, 1884, to October 8, 1884.
Scott, George W. ....	Jan. 2, 1878	
Shaw, William A. ....	Oct. 30, 1888	Out from January 25, 1884, to October 8, 1884.
Sherier, Julius M. ....	Nov. 2, 1885	
Simons, William U. ....	Apr. 30, 1872	Out from January 25, 1884, to October 8, 1884.
Simms, Alfred F. ....	July 6, 1882	
Slaughter, J. Pemberton .....	Aug. 17, 1883	Out from January 25, 1884, to October 8, 1884.
Stewart, Charles .....	June 30, 1883	
Stewart, Oscar D. ....	Sept. 4, 1878	Out from January 25, 1884, to October 8, 1884.
Stockman, William B. ....	Dec. 1, 1877	
Strong, Charles M. ....	Jan. 16, 1884	Out from January 25, 1884, to October 8, 1884.
Sullivan, Richard H. ....	Sept. 24, 1887	
Thompson, Arthur .....	Aug. 20, 1885	Out from January 25, 1884, to October 8, 1884.
Thornton, Walter S. ....	May 23, 1891	
Tuch, Charles B. ....	Apr. 11, 1879	Out from January 25, 1884, to October 8, 1884.
Tarr, Leonard M. ....	July 3, 1883	
Taylor, Nathaniel R. ....	Mar. 2, 1891	Out from January 25, 1884, to October 8, 1884.
Thompson, Charles D. C. ....	Mar. 12, 1889	
Thompson, Edwin C. ....	July 16, 1884	Out from January 25, 1884, to October 8, 1884.
Thompson, E. Herbert .....	Apr. 24, 1880	
Todd, George T. ....	Jan. 4, 1887	Out from January 25, 1884, to October 8, 1884.
Townsend, Theodore F. ....	Mar. 1, 1871	
Volker, Hermann .....	Jan. 15, 1890	Out from January 25, 1884, to October 8, 1884.
Von Hermann, Chas. F. ....	Nov. 17, 1884	
Vose, Elisha C. ....	Dec. 22, 1885	Out from January 25, 1884, to October 8, 1884.
Watson, James M. ....	Apr. 2, 1870	
Whiteside, James L. ....	July 17, 1880	Out from January 25, 1884, to October 8, 1884.
Williams, Henry E. ....	Mar. 24, 1876	
Wilson, George N. ....	June 5, 1890	Out from January 25, 1884, to October 8, 1884.
Wilson, Wilford M. ....	Sept. 25, 1885	
Wilson, Joseph B. ....	July 25, 1889	Out from January 25, 1884, to October 8, 1884.
Winters, Louis. ....	July 12, 1887	
Waldron, Bion L. ....	Jan. 3, 1890	Out from January 25, 1884, to October 8, 1884.
Walz, Ferdinand J. ....	May 12, 1885	
Welsh, Lucius A. ....	Aug. 2, 1873	Out from January 25, 1884, to October 8, 1884.
Widmeyer, James I. ....	Dec. 4, 1885	
Williams, Frank T. ....	Apr. 25, 1881	Out from January 25, 1884, to October 8, 1884.
Williams, John R. ....	Oct. 7, 1872	
Willson, George H. ....	Apr. 24, 1880	Out from January 25, 1884, to October 8, 1884.
Wood, Peter .....	July 17, 1880	
Wright, Marsden .....	Aug. 1, 1889	Out from January 25, 1884, to October 8, 1884.
Wurtz, George B. ....	June 18, 1890	
Young, R. Frank .....	Jan. 6, 1888	Out from January 25, 1884, to October 8, 1884.

## TITLES OF POSITIONS AND CLASSES OF EMPLOYEES.

*Titles of positions and classes of employees in the U. S. Department of Agriculture, indicating the nature of their several occupations.*

Plant physiologists.  
Plant pathologists.  
Botanists.  
Pomologists.  
Agrostologists.  
Cerealists.  
Mycologists.  
Crop culturists.  
Pharmacologists.  
Horticulturists.  
Gardener.  
Gardener's assistants.  
Foresters.  
Field assistants in forestry.  
Dendro-chemists.  
Collaborators in forestry.  
Photographers.  
Soil physicists.  
Soil scientists.  
Soil analysts.  
Assistants in soil survey.  
Drainage engineers.  
Tobacco expert specialists.  
Scientific aids.  
Scientific assistants in physics as applied to soils.  
Chemists.  
Assistant chemists.  
Biochemists.  
Chemical tabulators.  
Scientific assistants in analytical chemistry.  
Scientific assistants in agricultural chemistry.  
Scientific assistants in industrial chemistry.  
Scientific assistants in botany.  
Scientific assistants in plant physiology and pathology.  
Scientific assistants in horticulture.  
Scientific assistants in bacteriology.  
Scientific assistants in forestry.  
Scientific assistants in physiology and nutrition of man.  
Scientific assistants in animal pathology.  
Scientific assistants in animal production and dairying.  
Scientific assistants in rural engineering, especially as applied to road making.  
Scientific assistants in rural engineering, especially as applied to irrigation.  
Scientific assistants in practice of agriculture.  
Scientific assistants in agricultural statistics.  
Student assistants.  
Entomologists.  
Assistant entomologists.  
Scientific assistants in entomology.  
Scientific assistants in ornithology and mammalogy.  
Ornithologists and mammalogists.  
Statisticians.  
Compilers in statistics.  
Tabulators of statistics.  
Irrigation engineers.  
Irrigation assistants.  
Irrigation specialists.  
Public roads engineers.  
Public roads constructors.  
Road material engineers.  
Zoologists.  
Scientific assistants in zoology.  
Assistants in biochemic investigations.  
Veterinary inspectors in animal industry.

Meat inspectors in animal industry.  
Assistant inspectors in animal industry.  
Vessel inspectors in animal industry.  
Live stock agents in animal industry.  
Stock examiners in animal industry.  
Taggers in animal industry.  
Microscopists in animal industry.  
Assistant microscopists in animal industry.  
Microscope and other instrument repairers in animal industry.  
Animal husbandry specialists in animal industry.  
Professors of meteorology in the Weather Bureau.  
Meteorologists in the Weather Bureau.  
Medico-climatologists in the Weather Bureau.  
Forecast officials in the Weather Bureau.  
Local forecast officials in the Weather Bureau.  
Observers in the Weather Bureau.  
Section directors in the Weather Bureau.  
Station agents in the Weather Bureau.  
Messenger boys on stations in the Weather Bureau.  
Skilled artisans in the Weather Bureau.  
Batterymen in the Weather Bureau.  
Repairmen in the Weather Bureau.  
River observers in the Weather Bureau.  
Rainfall observers in the Weather Bureau.  
Cotton-region observers in the Weather Bureau.  
Sugar and rice observers in the Weather Bureau.  
Corn and wheat observers in the Weather Bureau.  
Fruit and wheat observers in the Weather Bureau.  
Storm-warning displaymen in the Weather Bureau.  
Clerks.  
Bookkeepers.  
Copyists.  
Typewriters.  
Stenographers and typewriters.  
Editors.  
Editorial clerks.  
Proof readers.  
Translators.  
Artists.  
Modelers.  
Illustrators.  
Engravers.  
Lithographers.  
Compositors.  
Printers.  
Pressmen.  
Folders and feeders in printing office.  
Library clerks.  
Library cataloguers.  
Scientific assistants in library science.  
Publication and document folders and mailers.  
Frank counters.  
Telegraph and telephone operators.  
Electricians.  
Steam engineers.  
Firemen.  
Assistant firemen.  
Machinists.  
Skilled mechanics.  
Plumbers.  
Blacksmiths.  
Carpenters.  
Painters.  
Skilled laborers.  
Messengers.  
Assistant messengers.  
Watchmen.  
Mere unskilled manual laborers, including charwomen.



**REGULATIONS GOVERNING OFFICERS AND EMPLOYEES AND THEIR APPOINTMENT IN THE U. S. DEPARTMENT OF AGRICULTURE.**

By the provisions of the Civil-Service act approved January 16, 1883, and the rules of the U. S. Civil Service Commission approved by the President, all positions in the U. S. Department of Agriculture, except those of mere manual, unskilled laborers including charwomen, are now embraced in the classified civil service, and appointments thereto can now be made only from certificates issued by the U. S. Civil Service Commission, except in the cases of special agents and experts.

All persons seeking information respecting the classified civil service and examinations for positions therein should address the U. S. Civil Service Commission, Washington, D. C. A manual of examinations for the classified civil service of the United States is published by the U. S. Civil Service Commission for the information and guidance of all persons interested therein.

No person can be appointed to the position of mere laborer or charwoman—that is, to do common manual labor or cleaning rooms, halls, stairways, etc., requiring ample physical strength and capacity—except in accordance with the regulations governing such appointments. No person so appointed can be allowed to do any duties that are held by the civil-service rules and regulations to be classified duties—that is, duties for which examinations have been or may be held by the Civil Service Commission.

Any person holding an appointment to a position in any other Department or officially connected with any other branch of the Government service will not, while holding such appointment, be employed in any capacity, even temporarily, in the U. S. Department of Agriculture.

To every person appointed to any position in the U. S. Department of Agriculture a written appointment, signed by the Secretary (or Acting Secretary) of Agriculture, will be issued, stating the title or name of the position to which appointed and describing in general terms the character of the service to be performed by and specifying the salary or the rate of compensation to be paid to the person so appointed and the specific roll or fund provided in the act making appropriations for the Department of Agriculture from which paid.

Every appointee will be required to take an oath (or affirmation) of office in the form prescribed by law before entering upon his duties, and file the same, together with a statement of legal residence, post-office address, and personal record, with the Appointment Clerk of the Department, on a form provided by the Department.

In every case in which the issue of a new appointment becomes necessary, as in promotions, reappointments, transfers, and changes of official designation, a new oath and a statement of personal record will be required, unless otherwise directed in the appointment.

The oath of office of appointees to positions in the U. S. Department of Agriculture may be taken before any officer having an official seal, with authority to administer oaths either by United States statutes or by local municipal law, and it must be properly certified under the hand and seal of such officer. The oath of office may also be taken before the Chief Clerk of the U. S. Department of Agriculture or before the chief clerk of any Bureau thereof.

Neither salary nor other emoluments will be paid to any employee until the required oath of office shall have been filed with the Appointment Clerk of the Department, nor until the appointee shall have reported for duty according to his instructions. If a specific date is named upon which the appointment is to take effect, salary will not begin until that date, although the oath may have been taken earlier.

REGULATIONS GOVERNING PROMOTIONS, ETC., IN THE U. S. DEPARTMENT OF AGRICULTURE  
IN FORCE ON JULY 1, 1903.

OFFICE OF U. S. CIVIL SERVICE COMMISSION,  
*Washington, D. C., December 1, 1896.*

In pursuance of the requirements of section 7 of "An act to regulate and improve the civil service of the United States," approved January 16, 1883, and in conformity with Rule XI of the revision of the civil service rules promulgated by the President on the 6th day of May, 1896, the following regulations governing promotions in the departmental service of the Department of Agriculture have been formulated by the Civil Service Commission after consultation with the Secretary of Agriculture, and are hereby promulgated:

*Regulation I.*

SECTION 1. All vacancies above those in the lowest class of any grade not filled by reinstatement, transfer, or reduction shall be filled by promotion: *Provided*, That if there is no person eligible for promotion, or if the vacant position requires the exercise of technical or professional knowledge, it may be filled through certification by the Civil Service Commission.

SEC. 2. Except as provided in section 1 of this regulation, a vacancy in any class shall be filled by the promotion of an eligible in the next lower class of the same Bureau, Division, or Office. When such vacancy exists the board of promotion review shall certify to the Secretary of Agriculture the names of the three eligibles in the Bureau, Division, or Office having the highest records of efficiency, and from these names the Secretary of Agriculture shall make his selection: *Provided*, That if there shall be in the Bureau less than three eligibles in the class next below that in which the vacancy exists, the board of promotion review shall certify as many in addition of the highest eligibles in the corresponding class of the other Bureaus as may be necessary to make a full certification.

*Regulation II.*

SECTION 1. No person shall be promoted to any grade from which he is barred by the age limitations prescribed by the civil service rules.

SEC. 2. No person whose record of efficiency is below 85 per cent of the possible maximum rating of his class or grade shall be eligible for promotion.

SEC. 3. No person occupying a position below the grade of clerk-copyist shall be promoted to that grade until he shall have been employed two years in the Departmental service and shall have passed, with an average percentage of 70 or over, the examination prescribed by the Commission.

*Regulation III.*

SECTION 1. The chief clerk of each Bureau, under the direction of the head thereof, shall keep a record of the efficiency of all employees under his supervision, and a similar record of employees not assigned to any Bureau shall be kept by the Chief Clerk of the Department.

SEC. 2. The record of efficiency shall be kept on such forms as may be prescribed by the Commission after consultation with the Secretary of Agriculture, and shall embrace the elements which are essential to a fair and accurate determination of the relative merits of employees.

SEC. 3. A record of those eligible for promotion shall be kept by the board of promotion review. The board shall have access to efficiency records, and may at any time call for a transcript of the same.

SEC. 4. The efficiency reports made by the chiefs of the several Bureaus, Divisions, and Offices of the Department of Agriculture respecting the value of the personal

services in the Department of each person serving under them, and filed with the Appointment Clerk for the Chief Clerk of the Department, shall be the basis of all promotions, demotions, and continuations on the rolls of the Department.

SEC. 5. The following shall be the form of efficiency report to be used in the Department of Agriculture:

U. S. DEPARTMENT OF AGRICULTURE,  
OFFICE OF THE SECRETARY,  
Washington, D. C., ....., 189..

TO THE CHIEF OF THE .....

You are directed to report upon the following-named person, as the questions herein propounded may require, and to file the report with the Appointment Clerk for the Chief Clerk.

J. STERLING MORTON, *Secretary*.

#### EFFICIENCY REPORT.

M ..... is employed under your supervision. This person's salary is \$..... per annum.

Upon what character of work is this person generally employed? Is it clerical? Supervisory? Routine? Is it of a varied and exceptional character? Does it involve original thought, consideration, or investigation? If it is skilled labor, state the kind, and whether it is supervisory or routine. If it is that of messenger, watchman, charwoman, or mere laborer, state the fact. ....

How high on a scale of 10 do you rate the quality of this person's work? .....

How high on a scale of 10 do you rate the quantity of work per month done by this person? .....

How high on a scale of 10 do you rate the punctuality of this person? .....

How high on a scale of 10 do you rate the deportment of this person? .....

How many days absent from duty on account of sickness during the six months last past? .....

How many days absent from duty otherwise than on account of sickness during the six months last past? ..... On account of annual leave? ..... Without leave? ..... Furloughed? .....

Does this person show, in your opinion, any special fitness for work of a higher intellectual character than that to which assigned? .....

Have you any further statement to make respecting this person? If so, make it here. ....

(Signed) .....

No. .... Chief of the .....

(MEMORANDUM RESPECTING THIS PERSON, COMPILED FROM THE RECORDS OF THE DEPARTMENT.)

First appointed ....., 18..., at a salary of \$..... per annum.

Classified civil-service record: .....

SEC. 6. An examination into the relative efficiency of employees, as shown by the efficiency record hereinbefore provided for, and such further tests as the Commission may deem necessary, shall constitute an examination for promotion from one class to another class. No person, except as herein provided, shall be eligible for promotion until he shall have passed such an examination.

SEC. 7. Examinations for promotion from one grade to another grade shall be conducted by the board of promotion examiners at such times as may be fixed by the Commission.

SEC. 8. Efficiency reports shall be called for by the Chief Clerk immediately before the termination of the first half of the fiscal year, and also immediately before the termination of the fiscal year, and may be called for at such other times as the interests of the Department seem to require.

JOHN R. PROCTER,  
*President Civil Service Commission.*



REGULATIONS GOVERNING APPOINTMENT TO POSITIONS OF MERE UNSKILLED LABORER  
UNDER DEPARTMENT OF AGRICULTURE IN DISTRICT OF COLUMBIA.

In the exercise of power vested in the President by the Constitution and by section 1753 of the Revised Statutes, the following regulations governing appointment to positions of mere manual unskilled laborer under the Department of Agriculture in the District of Columbia, having been recommended by the Secretary of Agriculture and the Civil Service Commission, are hereby approved and promulgated, to be effective from and after July 2, 1902:

1. These regulations shall not have the effect of bringing positions of mere laborer within the provisions of the act of January 16, 1883, known as the Civil Service Act, or of the rules in pursuance thereof, but the system of appointments hereby established shall be separate and distinct from the classified service.

2. No person shall be appointed to, or employed in, any position of mere laborer under the Department of Agriculture in the District of Columbia except in accordance with these regulations.

3. The Secretary of Agriculture shall appoint a board of labor employment of not less than three members, who shall be officers or employees of the Department of Agriculture, and who shall be divided as nearly as practicable between different political parties.

4. Each applicant shall make application on a form prescribed by the board of labor employment and approved by the Civil Service Commission, showing his age, physical condition, and other qualifications for the performance of mere manual labor, as indicated by his past occupations. The form of application shall be accompanied by certificates, or vouchers, from three reputable citizens who have knowledge of and are competent to testify as to the applicant's character and qualifications for performing manual labor.

5. Political or religious affiliations of applicants shall not be given any consideration whatever, nor shall political indorsements be received or entertained.

6. Applications of persons over 65 years of age will not be considered, except of honorably discharged United States soldiers or sailors of the civil war or of the Spanish-American war, and of those entitled to the benefits of section 1754, Revised Statutes.

7. Applications shall not be received from persons who are badly crippled or deformed, or from persons who are not citizens of the United States. Applicants who claim citizenship through naturalization shall be required to submit to the board documentary proof of their naturalization.

8. Applications shall be received by the board of labor employment at any time. On the first of January and the first of July of each year the board shall determine the relative fitness of each applicant who has filed his application in complete form within the six months preceding; the rating or determination of relative fitness shall be made on a scale of 100 and based upon a careful consideration of the applicant's age, his physical qualifications for performing mere manual labor, and his ability and adaptability to perform such labor, special consideration being given any former service as laborer in the Department. In rating an applicant no credit shall be given for any qualifications which he may possess other than those for the performance of manual labor, as above enumerated. The fact that an applicant can not read and write shall not be considered in determining his rating. Whenever in any case the board is unable to determine satisfactorily the rating of an applicant upon the information furnished in connection with the application, it may secure such further information as it may desire in respect to the applicant's character or ability, and may summon the applicant to appear personally before the board or its representative: *Provided*, That all information or matter which is given any consideration in determining the rating shall be reduced to writing and made a part of the applicant's papers. All applicants who receive a rating of 70 or more shall be deemed eligible. Whenever it may be necessary, in order to supply qualified persons for appointment, the board may at any time between January 1 and July 1 rate all applicants whose applications may be at such time on file and unrated.

9. As soon as the board has completed the rating of applicants for any period, as provided in section 8 of these regulations, it shall enter upon the register of eligibles the names of all those whom it has determined, in accordance with said section, to be eligible for the performance of mere manual labor, arranged in the order of relative fitness, with the highest first: *Provided*, That the names of eligibles who are entitled to preference under section 1754 of the Revised Statutes shall be placed at the head of the register in the order of their ratings. Separate registers of eligibles shall be kept, one for males and one for females. The period of eligibility shall be one year from the date on which the name of an eligible is entered on the register.

10. Whenever the Secretary of Agriculture desires to fill, by original appointment, an existing vacancy in the position of mere manual laborer, upon his request the board of labor employment shall certify to him from the male or female register, as indicated in the request, the three names at the head thereof which have not been three times certified. Of the three names certified the Secretary of Agriculture shall select one for appointment, and if, at the time of the selection, there are more vacancies than one, he may select more than one. The policy of the Department will be to select for appointment the highest of the three names certified, unless, for some reason satisfactory to the Department, it is deemed best to select one of the others. A person selected for appointment shall receive a certificate for a probationary period of six months, at the end of which period, if his conduct and capacity are satisfactory to the Secretary of Agriculture, his retention in the service shall be equivalent to his absolute appointment; but if his conduct or capacity be not satisfactory, he shall be notified that he will not receive absolute appointment because of such unsatisfactory conduct or want of capacity, and such notification shall discharge him from the service. Removal during the probationary period or after absolute appointment shall be made without any regard to political or religious affiliations. Whenever a person is separated from the position of mere manual laborer for any reason, he shall be given what may be known as a separation card, upon which shall be entered a statement of the reasons for his separation and of the character of service rendered by him.

11. Persons appointed through certification by the board of labor employment under these regulations shall not be assigned to the performance of any clerical duty or of any duty properly belonging to any position classified under the Civil Service law; and the compensation paid to any person appointed under these regulations shall not exceed fifty dollars per month or six hundred dollars per annum.

12. The records of the board of labor employment shall at all times be open to the inspection of the Civil Service Commission or its authorized representatives.

13. In connection with his monthly report of changes to the Commission the Secretary of Agriculture shall certify whether any person holding a position of mere manual laborer under these regulations has been assigned to clerical duty or any other duty properly belonging to a position classified under the Civil Service law.

14. The Civil Service Commission, whenever it shall find that any person is holding a position contrary to the provisions of these regulations, shall, after notice to the person affected and an opportunity for explanation or other statement, certify information of the fact of such irregularity to the Secretary of Agriculture, and then if such person be not dismissed within thirty days, to the disbursing and auditing officers through whom the salary or wages of such person is by law required to be paid; and thereafter such disbursing or auditing officers shall not pay or permit to be paid to such person any salary or wages which accrue after such certificate has been received by him.

15. These regulations may be amended either by the President or by the concurrent action of the Secretary of Agriculture and the Civil Service Commission.

THEODORE ROOSEVELT, *President*.

JAMES WILSON, *Secretary of Agriculture*.

Dated July 2, 1902.

AMENDED REGULATIONS GOVERNING APPOINTMENTS OF MERE UNSKILLED LABORER UNDER  
DEPARTMENT OF AGRICULTURE IN DISTRICT OF COLUMBIA.

*Regulation 9 amended.*

Section 9 of the regulations governing appointment to positions of mere unskilled laborer under the Department of Agriculture in the District of Columbia is hereby amended by inserting after the word "males" the words "between the ages of fourteen and twenty-one years and one for males between the ages of twenty-one and sixty-five years," and add after the word "females" the following words: "Between the ages of fourteen and twenty-one years, and one for females between the ages of twenty-one and sixty-five years," so that the section will read as follows when so amended:

"9. As soon as the board has completed the ratings of applicants for any period, as provided in section 8 of these regulations, it shall enter upon the register of eligibles the names of all those whom it has determined, in accordance with said section, to be eligible for the performance of mere manual labor, arranged in the order of

relative fitness, with the highest first: *Provided*, That the names of eligibles who are entitled to preference under section 1754 of the Revised Statutes shall be placed at the head of the register in the order of their ratings. Separate registers shall be kept—one for males between the ages of fourteen and twenty-one years, and one for males between the ages of twenty-one and sixty-five years, and one for females between the ages of fourteen and twenty-one years, and one for females between the ages of twenty-one and sixty-five years. The period of eligibility shall be one year from the date on which the name of an eligible is entered on the register."

(Signed)

JAMES WILSON,  
*Secretary of Agriculture.*

(Signed)

W. D. FOULKE,  
*Acting President U. S. Civil Service Commission.*

AUGUST 29, 1902.

*Regulation 10 amended.*

Section 10 of the regulations governing appointment to positions of mere unskilled laborer under the Department of Agriculture in the District of Columbia is hereby amended by adding after the words: "Whenever the Secretary of Agriculture desires to fill, by original appointment, an existing vacancy in the position of mere manual laborer," the following words: "In some specified Bureau, Division, or Office;" and by adding, after the words "upon his request the board of labor employment shall certify to him from the male or female registers, as indicated in the request, the three names at the head thereof which have not been three times certified," the words "to such specified Bureau, Division, or Office;" so that the section, as amended, shall read as follows:

"10. Whenever the Secretary of Agriculture desires to fill, by original appointment, an existing vacancy in the position of mere manual laborer in some specified Bureau, Division, or Office, upon his request the board of labor employment shall certify to him from the male or female registers, as indicated in the request, the three names at the head thereof which have not been three times certified to such specified Bureau, Division, or Office. Of the three names certified the Secretary of Agriculture shall select one for appointment, and if, at the time of the selection, there are more vacancies than one, he may select more than one. The policy of the Department will be to select for appointment the highest of the three names certified, unless, for some reason satisfactory to the Department, it is deemed best to select one of the others. A person selected for appointment shall receive a certificate for a probationary period of six months, at the end of which period, if his conduct and capacity are satisfactory to the Secretary of Agriculture, his retention in the service shall be equivalent to his absolute appointment; but if his conduct or capacity be not satisfactory, he shall be notified that he will not receive absolute appointment because of such unsatisfactory conduct or want of capacity, and such notification shall discharge him from the service. Removal during the probationary period or after absolute appointment shall be made without any regard to political or religious affiliations. Whenever a person is separated from the position of mere manual laborer for any reason, he shall be given what may be known as a separation card, upon which shall be entered a statement of the reasons for his separation and of the character of service rendered by him."

(Signed)

JAMES WILSON,  
*Secretary of Agriculture.*

(Signed)

WM. D. FOULKE,  
*Acting President U. S. Civil Service Commission.*

MARCH 31, 1903.

*Regulation 6 amended by Executive order.*

In the tests prescribed under regulations governing the employment of unskilled labor the element of age shall be omitted in the case of soldiers and sailors of the civil war, and their relative fitness decided by their physical qualifications, moral character, industry, and adaptability for manual labor.

THEODORE ROOSEVELT.

WHITE HOUSE.

Approved, July 8, 1903.

AGR 1903—31



*Regulation 2 amended.*

No person shall be appointed to, or employed in, any position of mere laborer under the Department of Agriculture in the District of Columbia except in accordance with these regulations. But in an urgent emergency when the work required to be done will admit of no delay and the services of a mere laborer are requested for a short period, a mere laborer may be employed, without reference to these regulations, for a period not in any case exceeding thirty days in any one calendar year. The same laborer not to be employed for a longer period than thirty days in any one calendar year.

JAMES WILSON,  
*Secretary of Agriculture.*

ALFORD W. COOLEY,  
*Acting President Civil Service Commission.*

SEPTEMBER 3, 1903.

## REPORT OF THE CHIEF OF THE DIVISION OF BIOLOGICAL SURVEY.

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U. S. DEPARTMENT OF AGRICULTURE,  
DIVISION OF BIOLOGICAL SURVEY,  
*Washington, D. C., September 25, 1903.*

SIR: I have the honor to submit herewith a report of the work of the Biological Survey for the fiscal year ending June 30, 1903, with outline of work for 1904, and recommendations for 1905.

Respectfully,

C. HART MERRIAM, *Chief.*

Hon. JAMES WILSON, *Secretary.*

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### WORK OF THE YEAR.

As heretofore, the work of the Biological Survey has been conducted along the three lines laid down by Congress: (1) Investigations relating to the geographic distribution of animals and plants, including biological surveys and the determination of the life and crop belts, in charge of the chief; (2) investigations of the economic relations of birds to agriculture, in charge of F. E. L. Beal; (3) supervision of matters relating to game preservation and protection and the importation of foreign birds and animals, in charge of T. S. Palmer.

#### SECTION OF GEOGRAPHIC DISTRIBUTION.

Field work in connection with the study of the geographic distribution of mammals, birds, and plants has been carried on over wide areas in California, Texas, New Mexico, Arizona, and Alaska, and also in several States of Mexico.

In California the preparation of a reliable biological map—a map showing the positions and boundaries of the life and crop belts—is rendered particularly difficult by the extraordinary topographic and climatic diversity of the land, distances of a mile or less sometimes bringing complete changes in the fauna and flora. Within the limits of the State may be found practically all the climates of the continent save the humid tropical. There are Alpine summits clad in perpetual snow, torrid deserts hotter and drier than those of Africa, and areas of excessive humidity where frequent fogs and heavy rains favor the growth of one of the noblest forests in the world.

In most States the running of a few lines suffices to give a key to the chief facts of distribution and makes it possible to map the zones with approximate accuracy, but in California nothing can be taken for granted, and it is necessary to spread a network of lines over the State before the complicated zone boundaries can be laid down with any

degree of confidence. Each valley and each slope has a climatic individuality and a corresponding fitness or capacity for particular crops. Some are cool enough for apples, cherries, and sugar-beets; others hot enough for almonds, raisin grapes, and the citrous fruits. Furthermore, in cases where several areas are adapted to the cultivation of the same crop, it frequently happens that the crop matures in the different areas at widely different dates. The commercial importance of this knowledge it is hard to exaggerate.

In the lowlands some striking differences are noticeable in the animals and plants of places of the same altitude and latitude. These differences may be explained by the circumstance that certain valleys are bathed in rivers of fog, while others are continually exposed to the scorching rays of the summer sun, which, beating for months through cloudless skies, dries up the moisture and bakes the soil. In the mountains it often happens that conspicuous differences in the fauna and flora occur on opposite sides of the same hill. This is caused by the angle of the slope with reference to the position of the sun, slopes facing the north and northeast having a temperature so much lower as to permit the existence of species different from those able to survive on the hot south and southwest slopes.

The agricultural interests of California are enormous. In the year 1902 the farm value of fruits and fruit products shipped from the State amounted to \$35,000,000; of wheat, barley, and flour, \$21,250,000; of hops and beet-sugar about \$2,000,000 each, or, in all, upward of \$60,000,000. To this should be added the values of vegetables and of dairy and stock products.

Stated in quantities, the shipments of fruits from California in 1902 were:<sup>a</sup>

*Exports of fruits from California in 1902.*

	Carloads.
Citrous fruits.....	22, 566
Cured fruits.....	15, 194
Green deciduous fruits.....	10, 039
Canned fruits.....	8, 063
Raisins.....	4, 757
Nuts.....	1, 091

Total exports of fruit in 1902..... 61, 713

During the same year the exports of wine and brandy amounted to 8,868 carloads, and of vegetables to 6,956 carloads.

In view of these facts and of the rapidly increasing agricultural population of the State, the importance of a biological map showing the areas adapted to particular crops is obvious. The preparation of such a map was undertaken by the Biological Survey some years ago and has progressed as rapidly as the available funds and difficult character of the country would permit. During the field season of 1902-1903 the work was continued mainly along the western slopes and foothills of the Sierra and in the Coast Ranges between Monterey and San Luis Obispo.

The field parties in charge of Vernon Bailey, chief field naturalist, continued work in Texas and New Mexico. In Texas operations were carried on in the eastern part of the State, about Kerrville and Rock-springs, and in the Panhandle region and portions of the area drained by the Rio Grande, Devils, and Pecos rivers. Explorations were

<sup>a</sup> Statistics from California State Board of Trade.



made also along the western slopes of the Davis and Guadalupe mountains, Texas, and in the Sacramento and White mountains and the Great Salt Valley in New Mexico. After the main parties had disbanded in the fall of 1902, an assistant was detailed to continued field work throughout the winter in the upper Pecos Valley, Tularosa Desert, and Capitan Mountains, New Mexico, and on the plains to the north and east of El Paso, Texas.

As in previous years, the field work in Mexico was in charge of E. W. Nelson, who, with his assistant, E. A. Goldman, worked in the States of Jalisco, Zacatecas, Michoacan, Guerrero, Morelos, Mexico, and Puebla, obtaining much material of value in determining questions of geographic distribution beyond our southern border.

A biological exploration of the lower Mackenzie River and the Barren Grounds between Great Slave and Great Bear lakes was begun in the spring of 1903. This work is in charge of E. A. Preble, who has previously conducted similar explorations in the Hudson Bay and Athabasca regions, for the purpose of obtaining material illustrating the status and distribution of boreal plants and animals.

Mr. Preble's work, in connection with recent field work in Labrador (conducted by Outram Bangs), in northwestern America (under the auspices of the American Museum of Natural History), and in Alaska (carried on for some years past by this Department), will, when completed, furnish a series of transcontinental boreal and arctic explorations, the results of which will make it possible for the first time to discuss with some confidence the relations and distribution of a large number of animals and plants whose homes are restricted to the far north. The work of the Department in Alaska has been greatly embarrassed and handicapped by lack of knowledge of the natural history of parts of America east of that territory.

During the past year our work in Alaska, in charge of Wilfred H. Osgood, was carried on along the base of the Alaska Peninsula, on both coasts, and on several of the lakes and rivers of the interior, notably Lakes Iliamna, Clark, and Becharof, and the Chulitna, Nushagak, and Ugaguk rivers. This region includes the northwestern limit of the Pacific coniferous forest, and also the meeting ground of several life areas. It is therefore a field of unusual importance for biological investigations.

#### SECTION OF ECONOMIC ORNITHOLOGY.

In the section of economic ornithology the work begun in previous years was pushed toward completion, and some new investigations were undertaken. As in previous years, two distinct lines of work were carried on: (1) in the laboratory, consisting of the examination of stomachs and crops of birds and the tabulation and comparison of their contents; and (2) in the field, consisting of the observation of birds in their haunts, more especially in orchards, gardens, and fields, to discover to what extent they damage crops or destroy insects that infest crops, and of the collection of such insects, seeds, wild fruits, and similar objects as are available for bird food, in order to compare them with the contents of stomachs taken in the same locality and thus determine whether birds choose food because it is most abundant or because it is most palatable.

During the year 2,566 stomachs were received from various collectors throughout the country, making the total number on hand 48,630.

Examination was made of 2,655 stomachs, distributed among various groups as follows:

Woodcock .....	20	Shrikes .....	20
Quail, grouse, etc. ....	1,169	Vireos .....	21
Woodpeckers .....	69	Warblers .....	127
Goatsuckers .....	13	Wrens .....	98
Flycatchers .....	71	Thrushes .....	48
Horned larks .....	166	Miscellaneous .....	365
Crows and jays .....	21		
Orioles .....	9	Total .....	2,655
Finches .....	438		

The results of investigations on a farm in Maryland carried on for several years by Sylvester D. Judd were published in a bulletin entitled "Birds of a Maryland farm" (Bull. No. 17 of the Biological Survey). This work has proved so useful as an aid in ascertaining the economic status of birds that it has been continued, and Doctor Judd has revisited the farm at intervals. The object has been to find out the relations and interactions of birds, insects, and farm crops; to ascertain if any direct checks upon ravages of insects through the actions of birds are noticeable; and to judge as nearly as may be what damage is done to crops by birds themselves, and to what extent this damage is offset by useful services rendered. The first edition of the bulletin was rapidly exhausted; another will soon be issued.

Field studies of the food habits of birds in the principal fruit-growing districts of California were begun in 1901 and have been since continued. F. E. L. Beal, who is personally conducting these important studies, revisited California in February and will remain throughout the fruit season of 1903, visiting the most important fruit-growing regions. In addition to careful field observations he secures stomachs of birds at the localities where the species are alleged to do the most harm and collects such insects and seeds as appear to be available for bird food.

Professor Beal is also investigating complaints of California bee keepers, some of whom claim that certain birds are a great detriment to their business, in that they eat large numbers of worker bees, and even that they sometimes capture queens during their marriage flights. The stomachs of birds sent in by these bee keepers failed, on examination, to support the charges, and it is desirable that enough additional material be collected in the immediate vicinity of the hives to settle the question definitely. In case the alleged damage shall prove to be real, field observations should be made with a view to the discovery of a remedy.

Thus far about 3,500 stomachs of California birds have been examined and the results tabulated. A report on the results may be expected within the year following Professor Beal's return.

Doctor Judd is continuing investigations of the food of American game birds. The subject of game protection has in recent years grown so much in public interest that an accurate knowledge of the food of birds of this group has come to be a necessity. In fact, the Biological Survey is constantly receiving inquiries as to the real economic status of this and that game bird, entirely apart from whatever value it may have as food or as an object of sport. A bulletin devoted to the quail, grouse, and other gallinaceous birds, and including also the woodcock, is well advanced toward completion. The food of wild ducks and other waterfowl will be the subject of another bulletin.

## SECTION OF GAME PROTECTION.

The work of game protection is now carried on under three acts of Congress: The Lacey Act of 1900; the egg act of 1903; and the Alaska game law of 1902. The work naturally divides itself into four well-marked lines: (1) Supervision of the importation of birds and mammals; (2) cooperation in restricting interstate shipments of game contrary to law; (3) protection of game in Alaska; and (4) collection and publication of matter relating to game protection.

## IMPORTATION OF FOREIGN SPECIES.

During the year 387 permits were issued for the entry of about 629 mammals, 53,106<sup>a</sup> birds, and 2,000 eggs of partridges and pheasants, an increase of 100 permits and 415 mammals compared with the record of 1902. These figures, however, do not show actual entries, as the number of birds imported is often less than the number stated in the permit. Several consignments of game birds were entered. Special efforts have been made to make the service more effective without undue hardship to the importers. The opportunity of evading the law by having birds brought in by passengers necessitates a more rigid enforcement of this feature of the regulations than would otherwise be required, particularly at the port of New York. Passengers bringing five birds or less have the option of declaring these with their other personal baggage before an officer of the customs and landing them without permit; but if more than five are imported a permit in regular form must be obtained. A strict account of the birds thus landed is kept by the customs authorities and reported at the end of each quarter. This arrangement has been found to work satisfactorily at New York and has recently been extended to San Francisco. It avoids much unnecessary friction and delay in the case of persons bringing in a few pet cage birds. Special arrangements also have been made at the port of San Francisco to facilitate the entry of mammals and birds consigned to the National Zoological Park. Heretofore such consignments have been received at frequent intervals, often without previous notice, from the United States consul at Newcastle, New South Wales. With a view to still further improving the service, a careful examination was made at San Francisco in June of the peculiar conditions attending importations from Australia and the Orient. Although the entries at San Francisco are few as compared with those at New York, the danger of introducing injurious species at that port is probably greater than at any other. The completion of the cable from San Francisco to Hawaii, by making it possible to communicate promptly with the inspector at Honolulu, adds much to the effectiveness of the service at both Honolulu and San Francisco.

The prohibition of the entry of certain injurious species is becoming generally understood, and the law seems to be accomplishing all that was expected of it. So far as is known, no prohibited species gained entry into the United States during the year. Two mongooses from Jamaica were killed at Philadelphia; one mongoose from the Philippines and two flying foxes, known also as fruit bats, from Australia, were destroyed at San Francisco; and a consignment of 50 flying foxes which reached New York from Singapore in December was reshipped

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<sup>a</sup> Exclusive of canaries. The total number including these birds is 254,633.



to Hamburg, Germany. A few specimens of prohibited species, most of them known to the Department, are in safe keeping in the possession of zoological gardens or private individuals. The mongoose, which was already distributed over Porto Rico and the islands of Hawaii and Oahu prior to the passage of the Lacey Act, has not, so far as known, spread to any new localities in the United States, but the European starlings near New York City and in the lower Hudson River Valley seem to be gradually extending their range into western Connecticut and southwestern Massachusetts. These species have obtained such a strong foothold in the localities named that all that can be done is to prevent them from spreading over other parts of the United States.

#### INTER-STATE COMMERCE IN GAME.

Through the cordial cooperation of the Attorney-General of the United States and State officials, cases arising from illegal shipment of birds and game have been acted upon more promptly than ever before. Special mention should be made in this connection of the services rendered by the State game commissioner of Illinois, the executive agent of the fish and game commission of Minnesota, and the game wardens of Iowa and Michigan. During the year 35 cases, involving shipment of 3,729 birds,<sup>a</sup> were reported to this Department, as against 39 cases involving the shipment of about 5,000 birds during the preceding year. Since the passage of the act 40 convictions have been secured in cases passing through this Department (25 in Federal courts and 15 in State courts), while about 20 more cases are still pending. In the two Federal cases arising in South Dakota the maximum penalty of \$200 was imposed. A number of the cases pending last year it was found necessary to drop because of the impossibility of securing satisfactory evidence or locating the defendants within the time required by the statute of limitation. As resources available for this work are necessarily limited, efforts during the past season were devoted largely to one or two areas in the West where experience had shown illegal shipments to be especially frequent. This concentration of effort gave more satisfactory results, especially in the number of convictions secured.

While illegal shipments of game still occur in large numbers, constantly increasing restrictions imposed by State laws render such shipments more and more difficult, as indicated by the devices resorted to by shippers in order to escape detection. The records of the year show an increase in the shipments by freight of game which formerly was forwarded by express, and in at least one instance game birds from the Northwest were found concealed in bales of hay shipped by slow freight. For successful prevention of such shipments more information must be collected in regard to the methods adopted by the trade in securing and forwarding game for market. It is gratifying to state that the Department has received the cordial cooperation of officers of express and railway companies. Much more attention is paid to such matters than heretofore; and in one notable case, that of an important railway system which formerly brought large quantities of game southwest to Chicago, no illegal shipments were reported. A personal examination also disclosed the fact that in one section of

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<sup>a</sup> Not counting 10 barrels of prairie chickens, which included an unknown number of birds.

North Carolina where game shipments were formerly made out of season vigilance of the common carriers had brought about an immediate cessation of shipments at the close of the open season.

The Department is also cooperating with local authorities in preventing the shipment and export of cage birds captured in violation of State laws. With two or three important exceptions the traffic in cage birds is now almost entirely restricted to foreign species and birds, like canaries, which are raised in captivity. As soon as certain States in the South have placed restriction on the capture and sale of mockingbirds, cardinals, and nonpareils, the wholesale capture of these valuable birds for sale in northern cities and foreign markets will be prevented.

#### PROTECTION OF GAME IN ALASKA.

The act of June 7, 1902 (the Alaska game law), has imposed heavy responsibility on this Department, which the absence of a specific appropriation has made extremely difficult to meet. Until competent wardens can be employed for certain important regions, it will be impossible to prevent wholesale destruction of game or to bring about even a reasonable observance of the law. At present all that is possible is to make the provisions generally known and to enforce restrictions governing shipment of game from the Territory. The work of the year was necessarily largely experimental. Two or three consignments of hides for the trade were held temporarily at San Francisco and Seattle, the effect of which action was to discourage such shipments. The wholesale shipment of deer hides totally ceased; but, as often happens in the case of a new statute, some of the provisions were misunderstood, and in certain quarters the impression gained credence that the shipment of black bearskins was prohibited, and the trade in these furs was temporarily curtailed. In spite of the prohibition of the sale of heads and skins of game animals, applications were received for the shipment of some trophies which were undoubtedly intended for sale. Prior to the 1st of May 59 permits were issued for the shipment of trophies and specimens, most of which consisted of bear, moose, and sheep from the Kenai Peninsula. Pending the issue of departmental regulations, about 30 applications were suspended in May and June on the understanding that permits would be issued before the opening of the season and arrangements made so that applicants who had not received their permits might ship trophies without unnecessary delay.

#### PELICAN ISLAND RESERVATION.

For several years past the State of Florida has made efforts to protect certain plume birds by special statute, and later, in 1901, by the passage of a general law prohibiting the killing of all birds other than game. The committee on bird protection of the American Ornithologists' Union has cooperated in this work, and for three years has directed its efforts to the preservation of a breeding colony of brown pelicans inhabiting a small island in Indian River, on the east coast, near the town of Sebastian. This island is less than 4 acres in extent, and during the breeding season is occupied by from 2,000 to 3,000 pelicans. It was found, however, notwithstanding the State laws and the presence of a special warden, that protection was inadequate. The Department, therefore, on request of the American Ornithologists'

Union and the Biological Survey, presented the matter to the Secretary of the Interior, requesting that, if practicable, the island be set aside as a reservation. This request was approved, and on March 14, 1903, the President of the United States issued an order setting aside Pelican Island as a reservation for the protection of native birds under the charge of the Department of Agriculture. A warden was at once appointed, and, with the continued cooperation of the American Ornithologists' Union, every effort is now being made to preserve the colony.

PUBLICATION OF INFORMATION CONCERNING BIRDS.

By a special provision in the Lacey Act the Secretary of Agriculture is required to collect and publish useful information relating to the propagation, uses, and preservation of birds. The publications thus far issued have related chiefly to preservation, and have comprised circulars, posters, and bulletins relating to State and Federal laws. Each year a bulletin has been issued giving briefly the provisions of State laws, particularly those which affect interstate commerce in game. The laws relating to birds other than game have also been collected and issued as a special publication (Bulletin No. 12). Posters and circulars have been distributed from time to time showing close seasons in the United States and Canada (including those in States which have county legislation), requirements of the shipping laws covering game, details relating to the enforcement of the Lacey Act, and similar matters. A condensed list of game officials and organizations was published in the Yearbook of the Department for 1902, and separates have been sent out wherever they would prove useful. The demand for these publications is large and is constantly increasing. Seventy thousand copies of the bulletin entitled "Game laws for 1902" were published, and Bulletin No. 12 has been republished or revised three times. So great has the demand now become for a general publication on game laws that it exceeds the resources of the Division, and such a publication can only be issued in very condensed form as a Farmers' Bulletin. But the appreciation of these publications is shown not alone in the demand for them, but also in the use made of them. Our "Game laws for 1902" was republished entire in the annual report of the game commissioner of Indiana; portions of the same bulletin were republished by the game warden of Maryland; diagrams and maps taken from it have been reproduced in books issued by private publishers, and both text and diagrams are often utilized by the press. The information thus distributed is most sought at the time when amendments to game laws are under consideration, and it is not too much to say that the rapid progress in bird and game protection during the last three years may be largely attributed to the publication by the Biological Survey of the various methods of protection which have been adopted by the several States. Especially is this progress noteworthy in the case of nongame birds, which are now protected by a practically uniform statute in 27 States. The bulletin on this subject has also attracted attention in other countries, particularly in Brazil and Mexico, and two notable articles have just been published advocating the adoption of a system of protection for nongame birds in the countries named similar to that which has proved so effective in the United States.

Numerous requests for data on foreign game laws have emphasized



the importance of securing information along these lines, and during the year, with the assistance of the Department of State, copies were secured from nearly all the European governments of existing statutes relating not only to game and nongame birds, but to payment of bounties for the destruction of noxious animals. The Division has also sought to secure copies of the licenses, resident and nonresident, now issued in several States, and to collect samples of the shipping tags and circulars used by the trade in interstate commerce in game. It has begun the preparation of a special report on methods of enforcing game laws in vogue in the several States, and on the distribution, migration, and protection of shore birds. As already stated, it has undertaken an extensive investigation of the food of game birds, and, in cooperation with the Division of Botany, is collecting material to illustrate the food of waterfowl, with special reference to the important ducking grounds in the upper Chesapeake and Currituck Sound.

#### BIRD MIGRATION.

During the year a bibliography of works relating to the occurrence of North American birds south of the United States was completed. It covers the period from the time of Linnæus to the present and contains 694 titles, divided into the following categories: West Indies, 160; Central America, 205; South America, 329. A bulletin is in progress on the distribution and migration of 16 representative species of shore birds, designed to serve as a basis for intelligent legislation as to the close seasons necessary for the preservation of the species and for their adequate protection in their winter homes. Maps have been prepared showing the summer and winter distribution of three of the most important of these species.

All of the migration material collected in the past nineteen years has been overhauled, rearranged, and catalogued to date, so that it is now readily accessible.

#### PUBLICATIONS.

The publications issued during the year include one number of North American Fauna (No. 22), one bulletin (No. 17), two articles, and a list of game officials and organizations in the Yearbook for 1902, one circular (No. 38), the report of the Division for 1902, one Farmers' Bulletin (No. 160), three large posters showing the close seasons for game, and eight reprints of former publications.

North American Fauna No. 22, by Edward A. Preble, treats of a biological investigation of the Hudson Bay region; Bulletin No. 17, by Sylvester D. Judd, on "The birds of a Maryland farm," embodies the results of long-continued observations on the economic relations of birds to local crops. The Yearbook articles are "Audubon societies in relation to the farmer," by Henry Oldys, and "The Agaves, a remarkable group of useful plants," by E. W. Nelson. Circular No. 38 is entitled "Interstate commerce in birds and game," and relates to laws covering the subject. Farmers' Bulletin No. 160 consists of a compilation of the game laws in force in the United States and Canada in 1902. The posters (Nos. 3, 4, and 5) give the close seasons for game in the United States and Canada, in Maryland, Virginia, and the District of Columbia, and in North Carolina and Tennessee. Three reprints were required of Farmers' Bulletin No. 54, "Some common

birds in their relation to agriculture," by F. E. L. Beal, making a total of 315,000 copies issued since 1897, the date of original publication. Reprints were issued also of Farmers' Bulletin No. 160, "Game laws for 1902;" Bulletin No. 12, "Legislation for the protection of birds other than game birds;" Circulars 36 and 37, "Importation of reptiles into Hawaii" and "Regulations for the importation of eggs of game birds for propagation;" and one Yearbook article, "The meadow lark and the Baltimore oriole" (1895).

#### INDEX OF MAMMAL NAMES.

The necessity for a complete and modern index of the family and generic names of mammals has led the Biological Survey to prepare such an index. This work, which has been in charge of T. S. Palmer, was completed during the year and the volume is now in press.

#### ROUTINE WORK.

During the year the routine work steadily increased. This work consists of correspondence, accounts of expenditures, preparation of reports and bulletins for publication, identifying and labeling specimens, care of collections, cataloguing bird stomachs received, tabulating details of stomach examinations, arranging and tabulating field reports, sorting and filing published matter valuable for reference, mapping distribution of birds and mammals, attention to the needs of field naturalists, developing photographic negatives and making prints from them, compiling game laws, issuing permits for the entry of foreign mammals and birds and for the export of trophies and specimens from Alaska, and cooperation in enforcing the various provisions of the act of Congress of May 25, 1900. The letters received during the year numbered about 5,400. Many of these were accompanied by schedules or reports, while others contained material also of permanent value. During the same period about 4,000 letters were written and 800 blank migration and other schedules were distributed to observers. The collection of photographic negatives made by members of the Biological Survey while in the field now numbers over 6,000, and is of constantly increasing value for purposes of study and illustration.

#### OUTLINE OF WORK FOR THE YEAR 1904.

##### SECTION OF GEOGRAPHIC DISTRIBUTION.

Field work in California for the fiscal year 1903-1904 will include a continuation of the biological survey of the foothill belt of the Sierra Nevada, a biological reconnaissance of some of the coast valleys, and a comprehensive study of the food habits of birds in a number of the important fruit-growing districts of the State. Some of the forest reserves of the Pacific slope will be visited for the purpose of determining their fitness for game refuges. It is hoped that a suitable home may be found for the herd of elk in Kern County, Calif., generously presented to the Government by Miller and Lux, and for such other game as may be received by the Government for the protection necessary to prevent its extinction.

In Texas, field work in the Panhandle region will be finished, connecting and finally completing the labors of previous years. The

results of this work will be included in a report on a biological survey of Texas, now well advanced toward publication.

Field work in New Mexico will be continued; northern and central Mexico will be visited for the purpose of completing former field work; and exploration in Alaska will be conducted in the northern spurs of the Rocky Mountains, about the upper and middle Yukon, and among some of the islands of the southern part of the Territory. A report on the work done about the base of the Alaska Peninsula in the summer of 1902 is nearly ready for the press, and will appear shortly. Explorations in the province of Mackenzie will be continued, and an effort will be made to determine the northern ranges and distribution of various forms of boreal life, so as to supplement the work already done about Great Slave Lake and Athabasca River and to furnish material for a report on the general region.

#### SECTION OF ECONOMIC ORNITHOLOGY.

The economic study of birds in the fruit orchards of California will be continued through the summer and early fall in order to ascertain the relation of certain important species to the horticulturist and ranchman. It is believed that careful field observations, supplemented by stomach examinations, will settle the question as to whether certain species are beneficial as destroyers of insects and weed seeds or injurious as devourers of fruit and grain. The results of these investigations will appear in a bulletin on "The economic relations of the birds of the Pacific slope."

Many parts of our country are subject to periodic invasions of noxious insects, which, by preying upon the farmers' crops, cause heavy financial losses. It is believed that if competent trained observers were sent to infested localities at the time such insects are in the act of devastating the crops much of value might be learned as to the controlling influence of birds in lessening the extent of the destruction and in checking the increase of the pests. With this object in view it is planned to investigate such outbreaks as may hereafter occur, in cooperation with the Division of Entomology, by sending a member of the Survey, when such a course is practicable, to study carefully the food habits of birds in the infested district.

For a number of years efforts have been made to secure stomachs of birds in certain groups of economic importance (as the upland game birds, flycatchers, swallows, thrushes, and titmice), and as soon as enough material to insure safe conclusions has been received reports covering the food habits of the species included in these groups will be published. With regard to certain groups concerning whose economic status much supplementary stomach material has come in, it is desirable to revise and supplement the earlier publications as soon as practicable. In the case of the woodpeckers, for example, more additional stomachs have been received than were used in the preparation of the original report.

It is expected that the bulletin on the food habits of the woodcock and upland game birds will be ready for publication before the close of the current year. The data for this investigation have been obtained by field observations and by laboratory examinations of more than 1,500 stomachs. The result shows that game birds do comparatively little harm to crops, while they consume large quantities of injurious insects and noxious weed seeds. Since game birds, in addi-



tion to their usefulness in connection with agriculture, have a high value as items of food and objects of sport, their habits deserve especially careful study.

#### SECTION OF GAME PROTECTION.

Plans for the coming year contemplate work upon a somewhat broader scale than heretofore. In addition to the issue of bulletins and posters containing summaries of the game laws, a report on game commissions and methods of enforcing game laws will be completed, and several circulars relating to topics of special interest in connection with game protection will be prepared. To enable the office to meet the numerous demands made upon it for information regarding game laws, a bibliography on this subject has been begun, as well as an abstract of the more important decisions of the courts which have a bearing on game protection. Work along both these lines will be continued during the year.

Certain species of game birds, notably the wood duck, woodcock, and upland plover, are rapidly becoming rare, and efforts will be made to obtain information respecting their present abundance in certain sections. It is proposed, if practicable, to make an investigation of the ducking grounds along the Atlantic coast, and also to obtain accurate information regarding the breeding colonies of certain water birds on the Pacific coast with a view to suggesting means for their protection.

Legislation of the past spring has made the Lacey Act effective in some States where heretofore shipment of game has been practically unrestricted. During the coming season special attention will be paid to the shipment of upland game from the States immediately west of the Mississippi and of waterfowl from the Southwest. Data will be collected respecting the methods employed by the trade in capturing, shipping, and storing game. In this connection attention is called to the fact that under present laws while the shipper may be made to pay the penalty for forwarding game illegally, it is almost impossible to convict the consignee or agent. The consignee is usually directly responsible for unlawful shipments of game, in that he offers the inducements through which the violations occur, and often lends direct aid to the shipper by furnishing information as to how the laws may be successfully evaded. Additional legislation will be necessary to fully overcome this difficulty.

Under the Alaska game law, regulations will be issued with a view to restricting export of heads and hides and furnishing special protection to certain kinds of big game. The caribou of the Kenai Peninsula and the walrus are both greatly reduced in numbers, and a close season of five years will be established for these species. In view of the large number of persons who visit the Kenai Peninsula to hunt big game, provision should be made at an early date for the appointment of wardens, to be charged with the enforcement of the game law, at least during the open season. Should an appropriation be made for this purpose it will be possible to make the law effective on the Kenai Peninsula and at other exposed points in the Territory at comparatively small cost.

#### BIRD MIGRATION.

During the current year bulletins on "Migration of North American warblers" and "Migration and protection of shore birds" will be pub-

lished and a report on bird migration in the Mackenzie Valley will be completed. The latter will show that the movements of birds in this region, so far as known, appear to differ from those in any other part of the world. It will be accompanied by maps intended to explain how these strange phenomena of migration are caused by the progression of the season.

During the last two years an investigation has been in progress concerning the migrations and winter ranges of 126 species of land birds which pass the winter in places south of the eastern part of the United States. It is expected that this work will furnish material for a study of the general problem of the bearing of migration routes of North American birds on the question of the origin of migration and the routes of dispersion on this continent.

### RECOMMENDATIONS.

The Biological Survey is charged by Congress with three distinct lines of work, each of coordinate value with the ordinary departmental "division." These are: (1) Section of geographic distribution; (2) section of economic ornithology; (3) section of game protection.

In submitting estimates for the fiscal year 1905 the following recommendations are respectfully made:

(1) That the Biological Survey be reorganized as a bureau with three sections as separate divisions.

(2) That an increase in the statutory roll of \$1,450 be granted to enable the Secretary to reorganize the Biological Survey as a bureau of the Department.

(3) That an increase of \$12,000 in the lump fund be granted to provide for the greatly increased demands for information and field work on geographic distribution, economic ornithology, and game preservation, and to enable the Survey to retain the services of trained assistants.

(4) That an increase of \$4,000 be granted to enable the Secretary to transport, fence, and maintain elk and other animals on forest reserves and other public lands. This is the minimum amount necessary to make a real beginning, since the current appropriation of \$1,000 for the purpose has proved utterly inadequate.





## REPORT OF THE FORESTER.

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U. S. DEPARTMENT OF AGRICULTURE,  
BUREAU OF FORESTRY,  
*Washington, D. C., October 28, 1903.*

SIR: I have the honor to transmit herewith a report of the work of the Bureau of Forestry for the fiscal year ended June 30, 1903, together with an outline of the plans for the work of the Bureau for the current fiscal year.

Respectfully,

GIFFORD PINCHOT,  
*Forester.*

Hon. JAMES WILSON, *Secretary.*

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### INTRODUCTION.

No previous year has seen such progress in forestry as the last. During this time public sentiment in favor of forestry became more marked, and practical forest work in the woods was better in quality and greater in amount than ever before. But great though the progress was in comparison with other years, actually it was small. The saving of the forests by wise use is but little nearer than it was a year ago, except for the wider spread of a knowledge of the nature and objects of forestry. The means available are yet too feeble to make much impression on the gigantic task of preventing the destruction of the lumber industry, the fourth among the great industries of the United States, and of using conservatively the forests which supply wood and conserve water for the use of the nation. The interests which these supplies serve and maintain are so vital to all our people that it can not be in question whether they shall be preserved, but only how best it can be done. The present provisions are wholly insufficient.

The very rapid progress of the sentiment for forest preservation during the last year has been nowhere more conspicuous than in the Western States. The greater part of it may be traced directly to the growing desire for development in irrigation which followed the passage of the National reclamation law. Except where special interests complicate and obscure the issue, the public opinion of the West has become unanimous in favor of forest preservation for the protection of the water supply, and practically so for the perpetuation of the supply of timber.

The necessity for the creation of forest reserves for their influence on the stream flow and timber supply is being better understood and is steadily receiving greater support where once there was opposition to the policy. The people of the West have not only come to understand that existing forests must be preserved if irrigation is to maintain its

continued development, but they are realizing also the importance of reserving lands once covered with forest, but now denuded, and the essential necessity that the Government should reclothe them with trees.

Decidedly the most important development of the year in forestry has been the awakening of the great lumber interests to the necessity for practical forestry and the hearty cooperation they have begun to give to the efforts of the Government for forest perpetuation. At the convention of the National Lumber Manufacturers' Association, held in Washington, more attention was given to forestry than to any other subject. The convention expressed itself in favor of the perpetuation of forests by wise use, and gave evidence of its good will by visiting the Bureau of Forestry in a body. Members of the association have since that time begun active cooperation with the Bureau with the object of forest preservation, and it may fairly be said that forestry has become a live issue in the minds of the great timber-land holders of the United States.

Only less important is the recent tendency of the railroads of the United States to consider the future of their timber supply and to take measures for its perpetuation. Railroads are among the greatest consumers of timber in the United States, and the preservation or destruction of vast areas of forest will depend on the attitude they assume toward this question, which is not less vital to them than to other users of wood.

A marked feature of the year is the increase in State cooperation with the Bureau of Forestry. The reference of State forest problems to the Bureau of Forestry for solution has reached the point where it involves a large and constantly increasing share of the attention of the Bureau, which could be given to few more profitable lines of work. The legislature of California has passed a law under which the State contributes \$7,500 a year for two successive years for a cooperative study of its forest problems by the Bureau of Forestry, which contributes an equal sum.

The legislature of New Hampshire appropriated \$5,000 for a systematic study of the forests of the State by the Bureau, including an examination of the proposed White Mountain National Forest Reserve. The State of Wisconsin and the Territory of Hawaii have each asked the Bureau to nominate a principal forest officer for them, while Maine, Michigan, and other States are in close and continual consultation with the Government forest officers.

The growing tendency of the Bureau of Forestry to devote its energies rather to Government work than to the assistance of private owners was marked during the past year. In spite of the rapidly increasing demand for assistance under the terms of Circular No. 21 on the part of private owners, a very large proportion of the work of the Bureau was given directly to Government forest problems on public land. But the greater part of the forests of the United States are and doubtless will remain in private hands, and their preservation is essential to the National safety and prosperity. While, therefore, it is right that the Bureau of Forestry should meet first of all the demands for strictly Government work, it can not neglect the requests for assistance from private owners without most seriously endangering the central object of its existence, which is the perpetuation of the forests of this country by wise use.

The widening of the field for practical usefulness of the Bureau in cooperation with private owners was shown by the growing number

and the eagerness of such demands. In meeting them it is the public rather than any private interest which is at stake. It is plain that a great opportunity has presented itself at a critical time. If this Bureau can be equipped to meet the demand before destruction has gone too far, the extensive protection of woodlands by the practice of forestry will certainly be attained. The only obstacle is present inability to handle the work. The Bureau is face to face with a situation with which it is unable to cope. Not only are the demands already made upon it far beyond its present capacity to meet, but there is grave danger that vast areas of the forests will have disappeared before the Bureau of Forestry can be made ready to use the opportunity to save them.

The making of working plans for the handling of small tracts of forest, such as woodlots, is a part of the most important educational work of this Bureau. The results of such work are by no means confined to the area or even to the neighborhood immediately concerned. Every such plan is a plain and practical demonstration of what is needed on similar holdings in the same region, and as such is of use to all those who wish or who may be brought to wish to manage and improve their own woodlands.

Large operations must always be conducted by trained foresters. Not so the small cuttings of the average farmer. The work of the Bureau in this direction must be along the line of teaching every woodlot owner to become his own forester. During the year the studies of woodlot problems already made have taken shape in publications of the greatest practical value to woodlot owners in nearly every region where such holdings occur.

Not less useful to the farmers of the treeless West are the planting plans prepared by this Bureau to assist them in selecting wisely and planting successfully the trees whose shelter gives so large an added value to their farms.

At the end of the fiscal year for which this report is made the following organization was, by your approval, established for the Bureau of Forestry:

Forester, Gifford Pinchot.

Forest Measurements, Overton W. Price, assistant forester, in charge.

Forest Management, Thomas H. Sherrard, assistant forester, in charge.

Dendrology, George B. Sudworth, assistant forester, in charge.

Forest Extension, William L. Hall, assistant forester, in charge.

Forest Products, Hermann von Schrenk, in charge.

Records, Otto Luebker, in charge.

## FOREST MANAGEMENT.

### PUBLIC LANDS.

#### NORTHERN MINNESOTA.

Under the provisions of the act of June 27, 1902 (32 Stat., 400), amending the act of January 14, 1899 (25 Stat., 642), known as the Morris bill, the Forester of the Department of Agriculture is charged with the selection, subject to the approval of the Secretary of the Interior, of 231,400 acres of land from certain of the Chippewa Indian reservations in northern Minnesota. This area includes 200,000 acres of pine land, 25,000 acres of agricultural land, and an amount equivalent to 10 sections to be reserved from sale or settlement. The act provides that the 225,000 acres of pine and agricultural lands, after



the pine has been lumbered under rules prescribed by the Forester and approved by the Secretary of the Interior, shall constitute a National forest reserve.

Field work under the act was begun early in August, 1902, and occupied an average of four men throughout the remainder of the year. The task before the Bureau was to ascertain what lands within the Chippewa reservations were best suited to the purposes of a National forest reserve, to select and draw up rules for conservative lumbering upon them, and to mark for reservation from cutting the 5 per cent of merchantable timber which the act provides shall be left standing as seed trees. The Bureau is charged also with the inspection necessary to enforce its rules for conservative lumbering. This work, which has been prosecuted with difficulty because of the remoteness of parts of the Indian reservations, their large size, and the faultiness of existing surveys and land classifications, has been carried on successfully throughout the year. A first selection of lands to constitute the Minnesota National Forest Reserve, embracing 104,459 acres, has been made by the Forester and approved by the Secretary of the Interior. The study necessary to a second selection comprising the remaining area has been made, and the official announcement awaits only the completion of Indian allotments within it by the Department of the Interior and the delineation of the flowage line for the Leech Lake and Lake Winnibigoshish reservoirs by the War Department. The 10 sections to be reserved from sale and settlement under the provisions of the act have also been selected and the selections have been approved by the Secretary of the Interior.

The necessary study was made to determine the best methods of reserving the 5 per cent of merchantable timber. The forest was actually measured upon a sufficient area to furnish a close estimate of the stand, and measurements upon felled trees were made to secure reliable volume tables upon which the selection of the 5 per cent for seed trees and a diameter limit for lumbering were based. Rules were drawn up to govern the lumbering and have been approved by the Secretary of the Interior, and the trees to be left standing have been marked upon over 6,000 acres.

In the Black Hills Forest Reserve, in South Dakota, material was gathered for a forest map supplementary to the working plan for the reserve, which was completed in 1901. The field work occupied one man for five months and consisted of a careful classification of the forest into its important types.

#### WEST POINT MILITARY RESERVATION.

As the result of the request of the Secretary of War upon the Secretary of Agriculture for technical advice governing the handling of military wood and timber reservations, a working plan for the reservation of the United States Military Academy at West Point was prepared during the past year. The forest comprises about 2,300 acres, and consists of a sprout growth of broad-leaved trees. Little cutting has been done for fifty years, but ground fires have annually burned off the vegetable mold and so injured the trees that the forest generally is in poor condition.

The purpose of the working plan is to prevent further damage by fire and gradually to improve the quality of the forest by judicious cuttings. The importance and value of the tract as a part of the equipment of the United States Military Academy and the urgent demands

for forest produce in the Quartermaster's Department demanded the preparation of a more detailed plan for protection and management than is generally necessary under forest conditions in the United States.

Field work in the collection of data for the working plan occupied two months. It was done by 16 students of the senior class of the Yale Forest School, under the direction of a field assistant of the Bureau of Forestry. A topographical map showing 20-foot contours was made as a basis for the forest map and for the assistance of the forester who will carry out the working plan. The field work showed that wood roads and trails enough already exist to serve as a basis for a thorough system of fire protection. Fire lines to supplement them were indicated on the forest map, and regular beats were established for the daily patrol of the tract. With the system of fire lines and the constant patrol which the working plan recommends, it is believed that fires entering from the outside or starting within the reservation will be easily controllable.

For the restoration of the stand to vigorous condition the working plan recommends careful improvement and reproduction cuttings. In situations where there are now fair stands of healthy trees the form of cutting recommended aims at the removal of the dead and dying and the inferior trees which retard promising growth. In poorer situations the purpose of the cutting will be to secure a new stand by making openings for seedling and sprout reproduction. Where it is improbable that the new growth will establish itself, seeding and planting of desirable species is recommended. Trees were marked for removal on sample acres to guide in future work. The forest was divided for administrative purposes into three ranges, and each range into compartments varying from 40 to 200 acres, according to the character of the stand and the natural boundaries. Each compartment was carefully cruised, described, and subdivided into forest types. In each type representative sample plots of from one-fourth of an acre to 1 acre were carefully selected. On each sample plot every tree was calipered and recorded by kind and diameter. Average sample trees—that is, representative trees whose diameters correspond as nearly as possible to the average diameter of all trees of the same kind upon the sample plot—were felled, and their volume and rate of growth were measured. The results for each sample plot were computed and tabulated. The total volume and the merchantable volume were obtained by multiplying the total and merchantable volumes of the sample trees by the number of trees which they represented. In this way units were obtained from which were calculated the stand and rate of growth of the more important species in all types and for the whole forest. Tables and curves showing the growth of the different species in diameter, height, and volume, tabulated summaries of sample plots, tables of stand of the various forest types, and estimates of the probable cost of the improvements recommended and of the probable income from the cuttings advised are included in the working plan.

#### INDIAN RESERVATIONS.

In compliance with the request of the Secretary of the Interior to the Secretary of Agriculture, field study of the Lac Courte Oreille, the Menominee, and the La Pointe Indian reservations, all in Wisconsin, was undertaken during the past year.

It was asked that an examination of each reservation and a report containing a description of the forest and recommendations for lum-

bering, in the form of rules, should be made, in order that they might form part of every contract for lumbering on these reservations. The request specified that the application of these rules should be supervised by an agent of the Bureau of Forestry. The field work occupied two men for two months. Its results were embodied in reports upon each of the three reservations, which include a full description of the forest and of the effect of past methods of management upon it, and recommendations of practical means for improving its condition. Each report contains a definite plan for the protection of the reservation from fire and rules for lumbering, which specify the lowest diameter to which trees should be cut and which provide for the avoidance of waste and of damage to standing trees.

#### PRIVATE LANDS.

During the past year the requests for assistance under the offer made in Circular No. 21 have increased in number and insistence. A marked growth of interest in forestry in the Southern States has taken place, and here, as in other regions, the Bureau is confronted by enormous opportunity for effective work. Although the preparation of working plans for woodlots and timber tracts goes steadily on as fast as the resources of the Bureau and the other claims upon them will permit, its inability to meet the demands for this branch of its work was never more evident than it is at present.

During the year 94 applications were received for advice and assistance in the management of private forest lands. Thirty-seven of these were for timber tracts, with a total area of 941,179 acres; 57 were for woodlots, with a total area of 5,868 acres. The total area of private lands in the handling of which assistance has been requested since the publication of Circular No. 21 is 5,656,171 acres, of which 5,640,579 acres are in timber tracts and 15,592 acres in woodlots.

Five great railroad companies have during the past year requested the cooperation of the Bureau to determine the advisability of the purchase and conservative management of forest lands by the companies for the production of railroad ties—the New York Central and Hudson River Railroad, the Pennsylvania lines west of Pittsburg, the Missouri, Kansas and Texas Railway system, the Erie Railroad, and the St. Louis and San Francisco Railroad Company. In view of the enormous quantity of timber used annually by these and other railroads and of the rapid decrease in available supplies, their attitude toward practical forestry offers in some ways an unparalleled opportunity for useful work.

#### WORKING PLANS MADE.

##### WOODLOTS.

Working plans based on thorough study on the ground were made for 48 woodlots, with a total area of 5,650 acres, in the States of Maine, New Hampshire, Massachusetts, Connecticut, New York, Pennsylvania, Delaware, New Jersey, Virginia, and West Virginia. Where cuttings were advisable a number of trees were marked for removal to guide in future work. The results of the examination of each woodlot, with detailed recommendations for its management, were embodied in a report to the owner. The general willingness shown to follow the advice of the Bureau in the handling of woodlots is very marked.



In cooperation with Mrs. Henry C. Potter, who contributed \$1,000 toward the cost of the work, of which \$579.39 was actually expended during the year, the Bureau completed during the past year a thorough study of woodlot conditions in Otsego County, N. Y. The purpose was to draw up simple rules for woodlot management for the use of farmers and other private forest owners in Otsego County. The field work, which occupied a party of four men for three months, included a careful study of the more important trees and of the effect of present methods of cutting upon the production of a second crop. At present the woodlots of Otsego County are in generally poor condition. The cutting practiced in the past has removed the best trees without regard to the forest of the future. The chief need of the woodlots was found to be a system of thinnings which will yield merchantable material and, by the removal of unsound and undesirable trees, will steadily improve the condition of the forest. The results of the field work have been embodied in a report which describes typical woodlot conditions in Otsego County and gives detailed instructions for bettering them. Upon several woodlots markings for thinnings are now being made in order to demonstrate exactly how the work should be done.

#### TIMBER TRACTS.

The field studies necessary for detailed working plans were made during the year upon five tracts, with a total area of 482,321 acres, in Maine, Pennsylvania, North Carolina, South Carolina, and Texas. The total amount estimated as the cost of these working plans to the owners was \$12,100, and the total amount actually expended was \$11,398.29.

#### SOUTHERN PINE.

One of the tracts for which a detailed working plan was prepared lies in Berkeley County, S. C., and covers an area of about 39,000 acres. The field work occupied a party of six men for three and a half months. The forest, which is typical of much of the eastern portion of the Southern pine belt, consists chiefly of Longleaf and Loblolly pines, about two-thirds of the area being pine land and the remainder Cypress and hardwood swamp. The forest is of good quality, and the flatness of the country and the situation of the tract along the Cooper River render logging unusually cheap. The field work included the actual measurement of 5 per cent of the forest, which afforded an exceedingly close estimate of the stand. The rate of growth of Longleaf and Loblolly pines and of Cypress was obtained, and also their volumes for given diameters.

The protection of the forest from fire, which is here, as elsewhere in the Southern pine belt, the most urgent problem in conservative forest management, was thoroughly studied on the ground. Present methods of lumbering and their effect upon the forest were carefully investigated, in order to formulate plans for work in the future which will insure the production of a second crop without seriously impairing present profits. Material was collected for the preparation of a detailed forest map showing the area and distribution of the forest types and the approximate stand per acre. The working plan contains a description of the methods employed in field work and a full record of its results. It includes recommendations for the protection of the forest from fire and for profitable modifications of present methods of lumbering. Among the important conclusions drawn

from the field study is the superiority for this region, under conservative management, of the Loblolly Pine over the Longleaf Pine, because of its much more rapid rate of growth and its equally plentiful reproduction.

#### PENNSYLVANIA HARDWOODS.

Another tract for which a detailed working plan was prepared is situated west of the Susquehanna River, about 15 miles above Harrisburg, Pa., and has an area of 2,321 acres. The forest has been clean cut, all of it once and some of it twice, for charcoal wood. The present stand consists of second-growth hardwoods, among which Chestnut, Chestnut Oak, White Oak, Black Oak, and Scarlet Oak are the predominating trees. The present owner intends to hold the property as a permanent investment. As the land is unfit for agriculture and contains no deposits of coal, iron, or other minerals, its capacity to yield returns lies only in the production of wood.

Three men spent six weeks in the field work necessary for the working plan. A thorough study was made of the forest and of the silvicultural characteristics of the more important trees. The local market for wood and timber of the sorts obtainable from the tract was investigated with a view to the disposal of the material from thinnings and improvement cuttings. Data were collected for a detailed map showing the distribution and character of the forest and the location of the more important streams and roads. It was found that on 1,659 acres the growth is still too small to be merchantable, but that on 662 acres the forest will now furnish telephone poles, railroad ties, and firewood. The market permits this material to be cut at a profit. The purpose of the working plan, therefore, was to determine how cuttings yielding salable material could be made with the best results in improving the quality of the stand. Since the land is capable of producing White Oak and Yellow Poplar, cuttings are recommended with the object of gradually replacing inferior coppice growth with a seedling forest of the more valuable kinds and at the same time maintaining the present proportion of Chestnut in the mixture, which is desirable on account of its good market value, its rapid growth, and its capacity to reproduce from the stump.

#### SOUTHERN APPALACHIAN HARDWOODS.

The tract of the Linville Improvement Company, comprising 16,000 acres in Mitchell, Caldwell, and Watauga counties, N. C., offered a somewhat unusual problem in the preparation of a working plan. The tract includes Grandfather Mountain, one of the highest peaks of the Southern Appalachians. Except for the cutting of Black Cherry fifteen years ago, little lumbering has been done. The present owners desire to cut the mature trees in such a way that the beauty of the forest will not be impaired, while its condition will be improved. The field work occupied a party of four men for three months. The stand was actually measured on 600 acres, the rate of growth of the more important species was determined, and a study was made of their silvicultural requirements and of their present market value. From the data obtained a map was made showing the distribution of the forest types and giving an approximate estimate of the stand of Ash, Cucumber, Basswood, and Hemlock, here the more important commercial trees. The problem of lumbering at a profit in such a way as to improve the condition of the forest without impairing its

beauty was carefully studied. The working plan contains detailed instructions for the location and execution of cuttings, so planned as not to injure standing trees and young growth, and to provide for reproduction.

#### LONGLEAF PINE IN TEXAS.

During the past year the study for a working plan for the forest lands of the Houston Oil Company in southeastern Texas was begun, and field work upon the holdings of the company in Jasper and Newton counties, comprising an area of about 300,000 acres, was brought near to completion. Longleaf Pine is here the tree of chief commercial importance. Lumbering has been in progress uninterruptedly for twenty years, and about 25 per cent of the entire tract has been cut over. During recent years the use of railroads instead of streams in transporting logs to the mills has had a marked effect upon the character of the logging. The problem of conservative management upon the forest lands of the Houston Oil Company falls, therefore, under three heads:

- (1) Management of virgin forest.
- (2) Management of forest lands lumbered before the construction of the railroads, which have merely been culled of the largest trees and which now contain a fair stand of merchantable timber.
- (3) Management of forest lands lumbered since the railroads were completed, in which the cutting has been comparatively close. Here Loblolly and Shortleaf pines were lumbered as well as the Longleaf, and in addition to the logging for lumber, piles and railroad ties were cut to a considerable extent from small trees.

The field work for this working plan has already required the services of 35 men for four months. Much information of general application was collected upon which to base the working plan for the entire tract. Careful measurements were made of 8,000 felled trees in order to determine the volume and rate of growth of Longleaf Pine, and a detailed study was made of present methods of logging. The timber was measured upon 8,432 acres.

The chief object of the working plan is to devise practical modifications of present methods of lumbering which will hasten the production and heighten the quality of the second crop. Study of the forest shows that it contains a large number of small trees which, under present market conditions, can be lumbered more profitably when they reach larger size. Since the proportion of small trees varies greatly in different localities, a map of the forest has been made, based upon its composition and dividing it into types and blocks for lumbering. The working plan fixes the diameter to which trees should be cut in each of these types and blocks, recommends practical measures to limit the waste in lumbering and to provide for satisfactory second growth upon cut-over lands, and outlines a simple and effective means of protecting the forest from fire.

#### SPRUCE IN MAINE.

The fifth tract upon which the Bureau completed field work during the past year includes 125,000 acres of the 275,000-acre tract of the Great Northern Paper Company in northwestern Maine. The field work upon 150,000 acres was completed last year, and the study for a working plan for the whole tract is therefore completed. The field work, which occupied a party of 32 men for three and a half months, was continued along the lines of the preceding year. The men were



divided into two parties, each fully organized, and with the knowledge of local conditions given by previous experience it was possible to push the work rapidly to completion. The stand was actually measured upon 5,481 acres, and the volume and rate of growth of 2,058 trees were determined. The most difficult problem with which the working plan had to deal was to increase upon cut-over lands the reproduction of the Spruce, which under present methods of lumbering does not compete successfully with the Balsam. The working plan will include a discussion of the silvicultural characteristics of the commercial trees and diagrams giving their rate of growth in diameter, height, and merchantable contents. Detailed regulations for lumbering will be given, which indicate a diameter limit for the Spruce below which no tree should be cut, and provide in other ways for the production of an abundant second crop. A detailed forest map will accompany the working plan showing the several forest types, the localities in which lumbering has been carried on, and the areas which have been burned over.

#### WORKING PLANS IN PREPARATION.

Under the terms of Circular No. 21 preliminary examinations were made during the year of ten timber tracts in the States of Alabama, Louisiana, Mississippi, South Carolina, New Hampshire, New York, and Pennsylvania, comprising a total area of 415,522 acres. Upon seven of the tracts examined it was found that the application of practical forestry would be sound business policy, and the preparation of detailed working plans was therefore recommended. For six of the seven tracts this recommendation was approved by the owners. The total estimated cost to them for the plans will be \$3,150.

One of the tracts examined during the year, for which the study required for the preparation of a working plan has been begun, is that of the Blue Mountain Forest Association, in Sullivan County, N. H. The forest, which comprises an area of 25,000 acres, consists mainly of Spruce in mixture with commercial hardwoods. The generally good quality of the stand and its nearness to market make the tract particularly favorable for conservative lumbering. The working plan will include a detailed forest map, an estimate of the stand of commercial timber and its rate of growth, and a thorough study of the present condition of the forest as a basis for plans for its best development. The present method of lumbering will be given careful study with a view to advisable modifications.

#### ALLEGHANY SPRUCE AND HARDWOODS.

Another tract for which the field work incident to a working plan was commenced during the past year comprises 50,000 acres of the holdings of the Baltimore and Ohio Railroad in Webster, Nicholas, and Pocahontas counties, W. Va. This mountain forest contains, in addition to valuable hardwoods—among which are Yellow Poplar, Basswood, Cucumber, Black Cherry, and Ash—a heavy stand of Spruce on the higher slopes. The composition and quality of the forest may be improved without appreciable reduction in returns from lumbering. The ownership of the tract is such that a steady income is preferable to a speedy return. In addition to estimates of stand and rate of growth, and to the results of silvicultural study, the working plan will consider the logging problem under existing conditions. The latter is here the most difficult factor in conservative

forest management, since the successful reproduction of the more valuable trees is complicated by the varying requirements of the many kinds in mixture.

#### MIXED FOREST IN NEW ENGLAND.

Another promising opportunity for practical forestry is offered by the tract of the Pike Manufacturing Company, comprising 3,000 acres in Grafton County, N. H. The collection of data necessary to the working plan was begun toward the close of the past year. The forest is a mixture of broadleaf and coniferous trees of the general type common to northern New England. The desire of the owners is to hold the tract permanently and so to manage it that it may continue to yield valuable crops of timber. Although it has been cut over, the forest contains enough merchantable timber to make lumbering very profitable if conducted in a careful and systematic way. The merchantable product of the forest may be disposed of at fair profit, while the danger from fire is slight if suitable precautions are taken during the lumbering.

#### PRIVATE FORESTS PUT UNDER MANAGEMENT DURING THE YEAR.

The working plan prepared during the past year for the tract of Mr. R. C. Neal, comprising 2,321 acres of second-growth hardwood land near Harrisburg, Pa., has been put into effect under the supervision of the Bureau. Markings for cuttings have been made upon 30 acres. This experiment in practical forestry is an exceedingly promising one, and since the forest is typical of large areas in southeastern Pennsylvania its conservative lumbering will have wide value as an object lesson.

At the request of the Houston Oil Company two field assistants of the Bureau of Forestry were temporarily detailed, beginning with June 1, to put conservative lumbering into effect upon the holdings of the company in Newton and Jasper counties, Tex., under the supervision of this Bureau and in accordance with its recommendations.

In connection with the preparation of the working plan for the forest of the United States Military Academy at West Point sample markings for cuttings were made and an arrangement has been reached by which the application of the working plan is under the immediate supervision of this Bureau.

The application of conservative management to twenty-seven woodlots in the States of Maine, New Hampshire, Massachusetts, Connecticut, New York, Pennsylvania, and Virginia, comprising a total area of 4,410 acres, is now under the supervision of this Bureau. The lack of available men renders it impossible for the Bureau of Forestry to supervise the application of all woodlot working plans which it prepares. Work is supervised only in those woodlots which present peculiarly difficult problems in their management and the conservative handling of which is of particular value as object lessons for the regions in which they lie.

The 104,459 acres which constitute the first selection for the Minnesota National Forest Reserve are now under the supervision of the Bureau, and the marking of trees to be left standing after lumbering is in progress.

The total area of private lands under the supervision of the Bureau in practical forestry, including those not mentioned above, is 679,194 acres; that of public lands, exclusive of forest reserves, is 106,759 acres.

### COOPERATIVE STATE FOREST STUDIES.

#### MAINE.

During the past year a study of forest conditions in Maine was begun in cooperation with the Maine forest commission, which contributed \$1,000 toward the expense of the work. Of this sum, \$679.12 was actually expended. This study was undertaken as the first step in a thorough investigation of the Maine forests. The field work occupied 10 men for about two and a half months. It included a careful study of the Spruce and, so far as possible, of the trees with which it occurs in mixture. Particular attention was given to determining the rate of growth of Spruce in diameter and height in different localities, its distribution, and the conditions necessary for its successful reproduction. In this first attack upon a very large problem it became evident that the best results could be gained from a thorough study of a typical forest area. With this in mind, Squaw Mountain Township, which lies in Piscataquis County, immediately south of Moosehead Lake, was selected for the work. This township, as a result of its varied topography, contains a number of the forest types which are characteristic of the forest growth upon large areas in central Maine, and includes also virgin forest, lands cut over for spruce and pine lumber, lands cut first for logs and then for pulp wood, and lands lumbered for hardwoods. Since logging has been going on continuously for six years just past there was good opportunity for measurements of rate of growth on stumps and felled trees as well as for a study of the effect of present methods of logging upon the forest.

The results of the work were published as a part of the fourth report of the forest commissioner of the State of Maine. A careful description of the forest is given, with tables showing the stand and the rate of growth of the commercial trees, and a summary of conclusions concerning the conservative management of forest lands similar to those of Squaw Mountain Township.

#### NEW HAMPSHIRE.

Toward the close of the past year the Bureau began the field work of a study of the forests of New Hampshire. This was made possible by an appropriation of \$5,000 by the State legislature to cover the expenses of the work, whose specific purpose is to ascertain present forest conditions and their causes. It will include the determination of methods by which the forests of the White Mountains and ultimately of the whole State may best be preserved. The field work is directed along the following main lines:

- (1) A study of the composition and quality of the forest and an estimate of the present stand. The results obtained will be used partly in the completion of the forest map of New Hampshire published in 1894.

- (2) A study of the characteristics of the more important trees and of the conditions necessary for their successful reproduction.

- (3) A study of the methods and extent of lumbering, of its effect upon the forest, and of practicable modifications to improve the condition of cut-over lands.



(4) An investigation, with the assistance of the United States Geological Survey, of the value of the forest as a conserver of the water supply. This includes the determination, first, of the size and condition of the watersheds tributary to large streams rising within the White Mountain region; second, of the effect of forest destruction upon the flow of these streams; and, third, of the amount and value of water power which is available at different seasons of the year or which is already in use.

(5) A study of the size, the value, and the character of the lumber industry of the State of New Hampshire.

#### CALIFORNIA.

During the past year a comprehensive study of the forests of California was begun. This work is the result of an act of the California legislature approved March 16, 1903, which provides that—

The State board of examiners is hereby empowered to enter into a contract with the chief of the Bureau of Forestry of the Department of Agriculture for the purpose of studying the forest resources of the State and their proper conservation, and especially with a view of formulating a proper State forestry policy, to the extent of \$15,000: *Provided, however*, That these expenditures for such purposes shall not be in excess of the amounts to be expended by the various departments of the Federal Government in collaboration.

The field work is carried on in cooperation between the offices of forest management and forest extension, since the study involves these two branches of the work of the Bureau. Seven men are now engaged upon the investigations incident to forest management. These include the collection of data for a forest map of California showing the distribution of the important trees and of the great forest types and indicating cut-over forest and chaparral. A careful study will be made of present methods of lumbering to find practicable modifications which will hasten the production of a second crop upon the cut-over lands. A similar study will be made of grazing and its effect upon the forest, to determine how it may best be regulated. The results of the work will be embodied in a report which will include, in addition to a detailed description of the work done and its results, recommendations for a forest policy for the State of California.

#### STUDIES OF COMMERCIAL TREES.

It has been possible during the past year to organize definitely the work of this Bureau in its studies of commercial trees and to extend their scope. With the increased number of trained men available it is now possible to conduct these studies in the best way—by studying each tree with small parties in various parts of its range. Carried out along these lines, the commercial tree studies now being made by the Bureau of Forestry are valuable contributions to our knowledge of North American forests.

In the studies of commercial trees conducted during the year particular attention was given to finding the average merchantable stand per acre and its rate of increase. The silvicultural characteristics of each tree were carefully studied, as well as those of the trees with which it occurs in mixture. The distribution of the tree, its behavior in mixture, the forest types in which it occurs, and the effect of elevation and other factors upon it were thoroughly investigated. The influence of present methods of lumbering upon its reproduction was

in every case given systematic study on the ground in order to ascertain the modifications necessary to insure reproduction upon cut-over lands.

During the year the study of Sugar Pine in California, begun in 1901, was completed. The field work occupied a party of seven men for three and a half months. Lodgepole Pine was studied in Park and Gallatin counties, Mont., by a party of four men for three months. Commercial hardwoods were studied in West Virginia, North Carolina, Tennessee, and Kentucky, occupying 31 men, organized into four parties, for four months. A study made of Balsam in the Adirondacks, because of its rapidly growing importance in supplementing the dwindling supplies of wood for paper pulp, is particularly opportune at the present time. A comprehensive study was made of Chestnut in southern Maryland with the specific purpose of determining the best management of woodlots for the production of that timber. The results of the work cover determinations of the stand per acre, the rate of growth of Chestnut seedlings and stump shoots, their silvicultural characteristics, and the method of management under which they may most profitably be grown. A study of Red Pine was begun in northern Minnesota. The field work, which occupied five men for three and a half months, was directed chiefly at the study of second growth in order to determine accurately what happens on cut-over lands under present methods of lumbering.

#### FOREST MEASUREMENTS.

The section of Forest Measurements computed and put into final form 25,113 valuation surveys, 23,455 stem analyses, 7,947 measurements of height, and 12,217 taper measurements during the past year. These data furnished information upon the present and future stand and the rate of growth in diameter, height, and volume of 42 species of trees in 14 States. In addition to the computation of data and the preparation of tables for working plans and commercial tree studies, a large number of miscellaneous results obtained in other lines of the Bureau's work were put into final form. It is noteworthy that during the past year the section of Forest Measurements has, without increase in force, completed nearly twice as many results as in the fiscal year 1902.

#### EXPENDITURES.

The total expenditures during the year by the office of Forest Management were \$71,192.48, or 24.4 per cent of the total appropriation of the Bureau.

Of the \$15,114.25 contributed toward working-plan studies begun or continued during the year 1902-3, \$12,864.82 had been expended at the end of the fiscal year.

#### WORK FOR THE ENSUING YEAR.

##### PUBLIC LANDS.

Under the request by the Secretary of the Interior upon the Secretary of Agriculture, the study of technical problems involved in the management of the National forest reserves and Indian reservations will be taken up as rapidly as the resources of the Bureau and other claims upon it will permit.

## PRIVATE LANDS.

The field work necessary to a working plan for the tract of the Houston Oil Company in southeastern Texas will be continued. Under the conditions of Circular No. 21, a working-plan study will be made of the 27,000-acre tract of E. P. Burton & Co. in South Carolina and of the 100,000-acre tract of the Kaul Lumber Company in southern Alabama. Particular emphasis will be laid upon the preparation of plans for the conservative handling of woodlots, which is rapidly becoming one of the most important lines of work in the Bureau.

## INSPECTION.

The marking of the timber to be left standing upon the lands which will constitute the Minnesota National Forest Reserve will be continued, and the rules for lumbering, which have been prepared by the Forester, will be put into effect under the direction of the Bureau of Forestry. The supervision of the markings of trees to cut and of conservative lumbering will continue upon those lands already under the general supervision of the Bureau, or which, as the result of the approval of working plans already completed or still to be prepared, are placed under supervision during the coming year.

## STATE COOPERATIVE FOREST STUDIES.

The forest study in California will be continued to completion, and the results of the first season's work will be embodied in a progress report. The study of the forests of New Hampshire will be completed along the lines already established. A study will be made of important forest problems in Vermont, especially of those which confront the private owner.

## COMMERCIAL TREES.

Balsam will be studied in Maine and work upon this species brought to a completion. The study of Southern hardwoods will also be completed and the results prepared for publication. The study of Red Pine in Minnesota will be continued, and during the winter a comprehensive study of White Pine in Minnesota and of the Southern pines will be begun.

## FOREST MEASUREMENTS.

The computation of field results obtained by the Bureau will continue.

## FOREST INVESTIGATION.

The division of Forest Investigation has covered a very wide field during the past year. Its work in turpentine orcharding has furnished its most notable contribution to the progress of forestry.

## TURPENTINE ORCHARDING.

One full season's test has been made of the cup system of turpentine, introduced by the Bureau, in comparison with the "box" method. The following very important facts have been established:

- (1) That the box is a destructive and unnecessary wound.



(2) That the cup system yields over 23 per cent more turpentine than the box.

(3) That the cup system gives uniformly high-grade rosins not possible from the box.

(4) That the cup system occasions the least possible injury to trees and will greatly lengthen their life and prolong the duration of the naval-stores industry, the extinction of which by the use of the box was imminent.

Through the circulation of Bulletin No. 40 and Circular No. 24, and through the personal instructions of Dr. Charles H. Herty, in charge of this investigation, the advantages of the cup system have been demonstrated to a large number of turpentine operators, of whom 20 are now using 345,000 cups. Many more operators would have installed the new system had it been possible to get cups at the proper time. The only present manufacturer of the cup could fill but a small number of the orders received. Widespread indorsement of the cup system by operators gives positive indication that it will be very generally adopted another season.

Experiments were continued at Ocilla, Ga., on some 20,000 trees to obtain still more accurate data on the comparative yield by the cup and the box systems. The present season's experiments have made it possible to install the cup system at about half the cost estimated for the season of 1902.

## FOREST DISTRIBUTION.

### MARYLAND.

In cooperation with the Maryland geological survey examinations were made of St. Mary, Prince George, and Kent counties. Reports of these studies are practically finished, and are to be published in the annual report of the State geologist for 1903. The reports embody (1) classification of wooded and other lands, the extent and location of which are shown on maps; (2) description of the forests and their composition by types and species; (3) stand of available merchantable and domestic timber by classes and species; (4) uses and consumption of wood by species; (5) effect of forest fires and other sources of injury, and recommendations for prevention and control; (6) recommendations for the increase and conservative management of the country's forest resources.

### TEXAS.

Following a study of the general forest resources of Texas, completed last year, a detailed study of the forests of Edwards Plateau (southeastern Texas) has been made. The forest growth of this region is important both for its influence on stream flow needed for irrigating adjacent agricultural lands and for supplies of commercial and domestic timber. Supplies of Post Oak and a brown-wooded cedar (*Juniperus sabinooides*) are abundant. The latter is important as a substitute for the scarce red-wooded pencil cedars. The results of this study are embodied in a valuable report, which will soon be ready for publication.

### MISSOURI.

Progress was made with the study of swamp forests in this State. The plan includes analyses of the factors which determine the distri-

bution and growth of Bald Cypress, and the Red, Black, and Cotton gums. There is a growing demand for information concerning these swamp timbers, which are rapidly coming into wide use.

## CALIFORNIA.

The Pacific coast tanbark industry was investigated, with important results. This investigation is mainly a study of the Tanbark Oak (*Quercus densiflora*) in California, the region of principal supply. The work includes the collection of data on the commercial range of the species, a study of the effect of cutting and bark peeling on the reproduction of the tree, and on the extension of its range, the relation of present consumption of bark and methods of cutting and peeling to future supplies, the quality and value of the bark, and the tannin content of various types of bark. Qualitative and quantitative analyses made of a large number of bark specimens by the Bureau of Forestry in its work of collaboration with the Bureau of Chemistry showed that the tannin content of the bark varies very greatly (12 to 18 per cent) with the region, soil, and density of stand, and that, through scarcity of supply, the genuine bark is extensively mixed with useless and inferior oak and alder barks. This practice is harmful to the tannage, and in several localities has done much to injure the reputation of genuine bark. The investigations have already made it possible to instruct buyers how to detect spurious and mixed barks.

## OHIO.

Investigation of the distribution of commercial hardwood timbers in Ohio has continued with special attention to available supplies and their relation to wood-consuming industries, and a large number of laboratory experiments were made to show the water content of green and of air-dried woods. The latter studies are directed toward determining the best method of air drying small-dimension sawn lumber.

A thorough investigation of the Basket Willow industry in Ohio was made as a part of a full study of Basket Willow culture in the United States.

## MICHIGAN.

A study of the causes which affect the distribution and growth of forests in the sandy Jack Pine plains of northern Michigan was completed. Detailed investigation of the influence which soils and soil modification in consequence of fires exert on the succession of forest types will assist in formulating recommendations for the recuperation, extension, and preservation of forest growth in the region. Much information that will be useful in dealing with these and similar forest regions was secured.

## IOWA.

Notes and photographs bearing on the distribution, growth, and commercial importance of the Sugar Maple and Cottonwood in Iowa were collected for use in future dendrological work.

## MONTANA.

Studies begun in 1902 of the factors which determine the distribution of coniferous forest types in Montana were completed this year

and embodied in a complete report, with maps and photographic illustrations.

### CEDAR SHINGLE INDUSTRY.

The cedar shingle industry of the Pacific Northwest was investigated during the fiscal year. The work included a study of the distribution of available supplies of shingle cedar, the scope and status of the shingle industry, its consumption of timber, the relation of present methods of cutting to future supply, and a study of cut-over cedar forests in relation to reproduction. In addition to field investigations, circulars were sent out to secure data not otherwise attainable from cedar shingle manufacturers. Nearly all the manufacturers addressed showed marked interest in the investigation.

### DENDRO-CHEMICAL INVESTIGATIONS.

The work of the dendro-chemical laboratory was conducted in cooperation with the Bureau of Chemistry, the Bureau of Forestry paying the salaries of experts and giving direction to the work, while the laboratory and appliances and immediate technical and administrative oversight were furnished by the Bureau of Chemistry. Investigations were made during the past year along the following lines:

(1) Study of the commercial value of gums and resins from forest trees of the Philippine Islands.

(2) Study of the production of tannins by native barks and woods. Analyses were made of the standard Chestnut Oak barks of the East and West and of the black oaks of the East. A series of analyses was also made of the woods of these trees to show their tannin content.

(3) Study of untried pulp woods to determine their usefulness as substitutes for standard woods now becoming scarce.

Considerable time was spent as a preparation for this work in a study of the structural and other characteristics of standard pulps, the felting qualities of which are known to meet the requirements of various papers. Of untried or little used woods, studies were made of the pulps produced by Black Gum, Cotton Gum, Colorado Spruce, Black Cottonwood, Narrowleaf Cottonwood, Aspen from the Rocky Mountains, and Engelmann Spruce.

(4) Experiments to determine the effects of certain poisonous chemicals on the life of trees. The purpose was to discover cheap and effective agents with which to destroy noxious woody growth.

Studies were also made of the damaging effects which illuminating and other gases and fumes have on the roots and leaves of trees. This Bureau is often asked to supply exact information on this subject. Several important problems have been presented for solution relative to the effects of fumes from smelters on the foliage and the life of nearby forest trees.

(5) Detection of adulterated spirits of turpentine. A thorough study was made of several hundred samples of commercial turpentine from all possible sources for the purpose of discovering a reliable test by which adulterated spirits could be detected. The most extensively used adulterant was found to be petroleum. The amount of spurious turpentine thus placed on the market is very considerable, and is increasing so rapidly that the Savannah Board of Trade applied to the Bureau for instructions as to how to detect the adulterated article. A simple and reliable test has been found for detecting the smallest per cent of petroleum in turpentine, and a description and illustration of the method has been prepared for publication.

### FOREST ENTOMOLOGY.

Investigations in forest entomology were conducted by the Division of Entomology in cooperation with this Bureau. The life histories and depredations of forest insects were studied in the principal timber forests of the East, South, and West for the purpose of devising methods



of controlling their ravages. One station was established in the Southern Longleaf Pine belt (Tryon, N. C.) and one in the Red Fir and Yellow Pine forest of Washington (Hoquiam), at which detailed studies and experiments which have already been of use were carried on. Much helpful advice was given to individual owners of timber tracts. Studies of and recommendations for the disposal of beetle-killed timber of the Black Hills Forest Reserve are notably important. Special chapters on the insects affecting the Red Fir, Western Hemlock, and Coast Redwood, and a Yearbook article (1902) entitled "Some of the principal insect enemies of coniferous forests in the United States," were prepared. Studies were likewise made of insects affecting commercial Pines and Cypress of North Carolina, South Carolina, Georgia, Florida, and Texas, Pine and Fir in the Black Hills, Priest River, and Olympic Forest reserves, Hickory in Michigan, Pine forests in New Mexico, tree Yuccas in southern California, Redwoods in California, Tanbark Oak in California, and Sitka Spruce and Giant Cedar in Washington.

Girdling experiments were applied to several hundred Pine trees in the Black Hills, South Dakota; to Yellow Pine and Cypress at Tryon and Boardman, N. C.; also, to Red Fir, Sitka Spruce, Giant Cedar, and Hemlock in Washington (Hoquiam), resulting in the accumulation of data which will be of special value in recommending methods for preventing losses. Excellent results are predicted.

At current stumpage values and wholesale prices of commercial products the annual loss from forest insect depredations is estimated to be about \$100,000,000.

#### MISCELLANEOUS INVESTIGATIONS.

##### BASKET WILLOW INDUSTRY.

During the past year a comprehensive study was made of the Basket Willow industry in the United States. The investigation included, for the sake of comparison, a careful review of the osier industry of European countries. This Bureau is constantly asked for information on the culture of willows.

An analysis of the present status of the Basket Willow industry in the United States shows that there has been a marked decline in the number of growers and in the quality and quantity of rods produced. This is due partly to the widespread destruction by insects of osier holts in the South and partly to a lack of proper methods of culture. The finest osier rods are now imported from French and German growers, whose methods of culture are practically unknown to American growers. With standard stock, the method of culture determines the commercial qualities of the rods, and it is evident that if the best methods are applied to American holts, high-grade rods can be grown here.

##### MAPLE-SUGAR INDUSTRY.

Further study of the maple-sugar industry was made during 1902. Special study was made of the care, improvement, and management of working groves and the creation of new groves by planting and by natural reproduction, and of the present and future commercial possibilities of the maple-sugar industry, which has declined.

One of the principal aims in this investigation is to point out meas-

ures through which adulteration may be checked and an honest product may be put on the market with greater profit to the producer than his present small returns.

#### COMMERCIAL OAKS.

The commercial distribution and growth of White Oak and Chestnut Oak in the Southern Appalachians was studied.

#### EXPOSITIONS.

Plans for the Bureau's forest exhibit at the World's Fair, St. Louis, Mo., 1904, have been completed. The fund allotted for the exhibition is \$7,500. Five thousand square feet of floor space in the Forest, Fish, and Game Building are to be devoted to the exhibit.

#### CORRESPONDENCE.

The giving of original and compiled information by letter on various technical subjects constitutes an important part of the work of the Dendrologist. One thousand eight hundred and forty communications were prepared during the year—a great increase over the previous year. The subjects of correspondence vary greatly. A large percentage of these letters asked for information either not yet published or widely scattered through various documents.

#### EXPENDITURES.

During the fiscal year ending June 30, 1903, the total expenditure for forest investigations was \$27,714, which is 9.5 per cent of the total appropriation.

#### WORK FOR THE ENSUING YEAR.

##### DENDROLOGICAL STUDIES.

##### DESCRIPTIONS OF TREE SPECIES.

Bulletins descriptive of North American tree species, including their geographical and commercial range, will be in preparation. Five separate regions will be considered—the Northeastern, Southeastern, Rocky Mountain, Southwestern, and the Pacific slope (including adjacent islands and Alaska). These bulletins will supply simple, concise descriptions of our forest trees, and should be particularly useful to lumbermen, architects, engineers, and operators of wood-consuming industries, who are constantly applying to the Bureau for information which is nowhere available at present.

##### COMMON NAMES OF TREES.

Serious difficulties are constantly arising among architects, builders, engineers, nurserymen, and other wood consumers because of the present confusion in the common names of trees. Careful study will be given to the subject during the coming year.

## SPECIAL STUDIES.

Studies of swamp forests in Missouri and Arkansas will be continued during this field season, and a special study will be made of the distribution, growth, and commercial value of swamp hardwood forests in Texas.

Monographic studies of the Black and Red oaks will be carried forward to completion. This work will be concerned mainly with the silvicultural requirements and growth of these oaks for the purpose of completing unfinished reports by the late Doctor Mohr.

The study of the distribution, reproduction, and ownership of the Big Trees of California will be continued, and should be followed by important recommendations for the preservation of the most unique of our forests.

A systematic study of the timber and other *Acacia* tree species indigenous and naturalized in California, Arizona, New Mexico, and Texas will be continued.

Experiments will be continued on the Potomac Flats to determine the best methods for the production of commercial Basket Willow rods, the best supplies of which are at present imported largely from foreign countries.

## TURPENTINE ORCHARDING.

Field experiments will be continued at Ocilla, Ga., and elsewhere to compare still more widely and accurately the cup system and the box system, to improve the cup system further, and to increase the yield. A study of the French system of turpentineing is being made on the ground.

## FOREST EXHIBIT.

The Bureau's exhibit at the World's Fair, St. Louis, Mo., 1904, will be installed during the present fiscal year. The detailed preparation is going forward as rapidly as possible.

## FOREST LIBRARY.

The usefulness of the library will be increased during the coming year by making available for reference, by title, author, and subject index, all essential published matter bearing on forestry and closely related subjects. Summaries of published information on special subjects will be made by the library force. Material is being collected for a general history of State forest legislation.

## FOREST PHOTOGRAPHS.

The photographic laboratory will be continued as heretofore.

## FOREST EXTENSION.

The forest-extension work of the Bureau of Forestry has to do with the creation of forests where at present there are none. It continues the cooperative planting carried on by the Bureau with private land-owners since 1899, and includes forest planting on the public reserves, the investigation of forest fires, studies in forest replacement, and the reclamation of shifting sand dunes.





*Cooperative planting—Continued.*

## PLANS MADE PRIOR TO JULY 1, 1903—Continued.

No.	State.	Applica- tions.	Plans made.	Area for which plans were made.
		Number.	Number.	Acres.
8	Indian Territory .....	2	2	29.5
9	Indiana .....	12	12	1,038
10	Iowa .....	8	8	42.9
11	Kansas .....	46	44	747
12	Kentucky .....	3		
13	Maine .....	1	1	700
14	Maryland .....	1		
15	Massachusetts .....	13	12	1,939.5
16	Michigan .....	6	6	319
17	Minnesota .....	9	9	48
18	Missouri .....	2	1	5
19	Nebraska .....	23	23	190.86
20	New Hampshire .....	5	5	84
21	New Mexico .....	4	2	440
22	New York .....	7	6	130.8
23	North Carolina .....	2	2	280
24	North Dakota .....	27	27	187.62
25	Ohio .....	7	4	17.4
26	Oklahoma .....	27	25	276.68
27	Pennsylvania .....	8	7	705.72
28	Rhode Island .....	4	4	289.20
29	South Carolina .....	2	2	100
30	South Dakota .....	32	31	252.23
31	Texas .....	22	19	156.23
32	Virginia .....	6	2	96
33	Vermont .....	3	3	554
34	Washington .....	1		
35	West Virginia .....	2	1	10
36	Wisconsin .....	3	2	130
Total .....		328	292	10,807.47

The planting plans of the past year, like those prepared before, are mostly for farm woodlots of not more than 10 to 20 acres. There have, however, been numerous exceptions. One of the plans was for the Presidio Military Reservation, in the city of San Francisco, Cal. This reservation consists of 1,800 acres, 400 acres of which were planted in timber between the years of 1888 and 1895. The growth of the planted trees has been vigorous, and the stand has become very dense. Recommendations were made for thinning the present stand of timber and for planting an additional area of 108.7 acres. An appropriation of money by the War Department has already been made for this work, which is now in progress. Both thinning and planting should be completed within the next two years.

In May, 1902, Governor White, of North Dakota, made application for the assistance of this Bureau in the preparation of planting plans for the grounds of several of the State institutions. The plans have been made during the past year. The plantations provided for in the plans made will furnish examples of protective shelter belts such as are necessary in the Northwestern plains. The plans have been accepted by Governor White and transmitted by him to the various institutions concerned. The planting under them should begin next spring.

In the spring of 1902 the Fort Worth and Denver City Railroad made application to the Bureau of Forestry for its assistance in the encouragement of forest planting by farmers in the prairie region of Texas through which the road extends. An examination of the land lying contiguous to the railroad between Fort Worth and Texline, Tex., was made by the Bureau of Forestry, and conferences on forest

planting were held with landowners at numerous points. Ten plans were made as a result of this work, and upward of 600,000 trees were planted last fall and this spring in accordance with them. The Fort Worth and Denver City Railroad cordially supported the work by giving transportation to the agents of the Bureau of Forestry and hauling free of charge the trees which were ordered for planting under its plans.

During the year a plan was prepared for the planting of 640 acres in Cullman County, Ala. This land was originally covered with Longleaf and Shortleaf pine, but after being cut over was burned by successive fires until reproduction failed. The plan included recommendations for protection of the land from fire and its planting to Loblolly Pine, White Oak, Post Oak, and Chestnut. The request for this plan is significant of the growing interest of the Southern States in the restocking of cut-over lands.

#### PROGRESS OF PLANTING.

In practically all cases in which plans were prepared during the past year the owner was ready to proceed with the planting at once. In most cases the planting will be completed within two or three years. Planting also continues under plans previously made.

The Metropolitan Water and Sewerage Board of Massachusetts during the year has planted 225 acres under the plan prepared by the Bureau in 1900. About 400 acres, therefore, have been planted around the edges of the immense Wachusett reservoir of the Boston water supply.

The Currituck Shooting Club, whose grounds lie between Currituck Sound and the Atlantic coast, in Currituck County, N. C., began during the year the planting of trees and shrubs for the reclamation of shifting sand dunes on the club grounds. The preparation of the ground for this planting was done by the club under the Bureau's direction during 1902.

The city of Woonsocket, R. I., has begun extensive planting under plans prepared by the Bureau last year. Like the Metropolitan Water Board, the city of Woonsocket has a large area of bare land surrounding its storage reservoir. This land must be planted to protect the water. Planting began in the fall of 1902 by the setting out of 10,000 White Pine, and was continued during the spring of 1903.

#### RESERVE PLANTING.

A good beginning in planting on the public forest reserves was made during the year. Work has been in active progress on the Dismal River Reserve in Nebraska and the San Gabriel Reserve in California, on both of which there is urgent necessity for establishing forests without delay.

#### DISMAL RIVER RESERVE.

On the Dismal River Forest Reserve, one of the two reserves established in the sand hills of Nebraska for forest planting, the boundary lines have been surveyed and marked. Nine sections, including the district which is to be planted first, have been surveyed and mapped. Since the reserve does not afford a satisfactory nursery site, a tract of 240 acres adjacent to the north side and lying in the valley of the Middle Loup River, about 2 miles west of Halsey, was set aside by



Presidential proclamation for a forest nursery. Eighty acres of this bottom land have been fenced, and a seed bed of 1 acre has been prepared and covered by suitable framework for the protection of seedlings. This bed has now been entirely seeded to pine and spruce. Materials have been obtained for the construction of an additional seed bed of the same size as that already made, so that space has been provided for the growing of 2,000,000 plants.

During the fall of 1902, 30,000 seedlings of the Western Yellow Pine were collected in the Black Hills Forest Reserve and 10,000 Jack Pine seedlings in the woods of Minnesota for the Dismal River Reserve. During the past spring 60,000 additional seedlings were obtained in the woods in the vicinity of Brainerd, Minn. These 100,000 trees were planted in the north part of the reserve. The planting of these forest-pulled seedlings is for the purpose of determining how far that method is practicable. The present indications for the survival of a large percentage of the trees are excellent.

The cost per 1,000 of collecting, shipping, and planting these seedlings was as follows:

Species.	Cost of collecting.	Freight.	Cost of planting.	Total.
Jack Pine -----	\$3.85	\$1.20	\$1.46	\$6.51
Western Yellow Pine -----	4.58	.56	1.72	6.86

Seven thousand Cottonwood and 3,000 willow cuttings were planted along the Middle Loup River and on the adjacent hills.

In addition to the sowing of the seed bed and the planting of trees and cuttings, 10 acres in the sand hills adjacent to the nursery site were sown with Red Cedar, and 24 acres with Jack Pine, Western Yellow Pine, and Blue Spruce.

A temporary building was erected near the nursery site to provide protection for tools, implements, and supplies. A well was sunk and a windmill erected to supply water for the irrigation of the beds. A reservoir of  $1\frac{1}{2}$  acre-inch capacity was constructed some 60 feet above the seed beds. The level of this reservoir gives ample head for using the water either in the seed beds or in the protection of the buildings in case of fire. A complete irrigating system has been established.

It is significant of the local interest taken in the Bureau's work that the commissioners of Thomas County have recently laid out a road direct from the station at Halsey to the Bureau's headquarters, and have bridged the river, at a cost of \$800.

#### SAN GABRIEL FOREST RESERVE.

##### SEED PLANTING.

The work of planting on the San Gabriel Forest Reserve was greatly extended by this office during the past year. Planting was begun on Brown Mountain, at the western extremity of the San Gabriel Reserve, in November, 1902. This mountain, which has been heavily burned for many years, is now bare of timber and but scantily covered with brush. The planting was done at an elevation ranging from 2,000 to 4,500 feet. For the larger part of the work seeds were planted. Seed spots were dug from 6 to 12 inches deep and 2 feet across, the surface was smoothed, and from 8 to 15 seeds

were planted in each spot. The spots were from 6 to 15 feet apart, or an average of about 375 per acre, and, when possible, were placed in shelter. The total cost of planting was \$7.41 per acre, not including cost of superintendence. The force engaged in the work consisted of two members of the Bureau of Forestry, with from 12 to 15 laborers. The amount of seed planted in this way was as follows:

	Pounds.
Knobcone Pine .....	85
Coulter Pine .....	1
Torrey Pine .....	2
Gray Pine .....	33
Western Yellow Pine .....	26
Sugar Pine .....	45
Incense Cedar .....	9

The seed of the Knobcone Pine planted in November began germinating in January, and the Incense Cedar a little later. From this time until April the seedlings appeared in abundance. Owing to the great numbers of birds (linnets), precautions had to be taken for the protection of the seedlings. Later in the season, with the growth of more vegetable food, the birds' attack largely ceased. In addition to the birds the rabbits did great damage by biting off the young and tender seedling trees.

#### SEED BEDS.

During the past year a seed bed 15 by 50 feet has been constructed in Pasadena, where there are ample facilities for water. On account of the presence of birds it was necessary to cover this entire inclosure with wire netting. This bed has now been wholly planted to Pine and Incense Cedar seed.

The thanks of the Bureau are due to Mr. J. R. Bell, forest ranger, Idyllwild, Cal., for assistance in securing seed for planting; to Mr. William G. Kirchhoff, president of the Los Angeles County Water and Forest Association, who gave \$262 to the work, and to the Pasadena Board of Trade for a contribution of \$600 for the same purpose.

#### SEED COLLECTING.

For the planting both in Nebraska and in California this Bureau has itself collected the seed. This was usually necessary because the seed was not to be found in the market, and in all cases it has insured seed of fresh quality and from suitable places. In addition the Bureau has acquired valuable information in regard to the collection and treatment of tree seeds. In all, 856 pounds of seed have been collected.

#### FOREST REPLACEMENT.

Investigations to determine methods of improving thin forest stands without resorting to expensive planting were begun during the past year. Three distinct studies have been carried on, one of the reproduction of hardwoods in Oklahoma, another of Western Yellow Pine on the Prescott Reserve in Arizona, and a third of White Pine on abandoned fields and pastures in New England.

#### REPRODUCTION OF HARDWOODS IN OKLAHOMA.

The natural line between timber and prairie which extends southward through Missouri and eastern Kansas bends distinctly westward

in Oklahoma to include the Wichita Mountains, which consist of several low ranges separated by high prairies or parks. For the most part the valleys at the foot of the mountains and the higher slopes are covered by a scattering growth of hardwoods, consisting principally of Post and Black Jack oaks. The land until 1901 was controlled entirely by Indians, who used it for grazing, and was regularly burned off each year for the improvement of the range. In the longer settled portions of Oklahoma, where originally there were similar thin stands of oak, a dense growth of young oaks sprang up at once after the settlement of the country and the end of the fires. The chief purpose of this investigation was to find whether such reproduction is to be expected in the Wichita Mountains.

A large number of silvicultural and reproduction surveys were made on the Wichita Forest Reserve, which includes the principal mountains, and evidence was gathered which shows that if fires are kept out of the reserve and grazing somewhat limited a strong though not perfectly distributed reproduction of species such as Post and Black Jack oaks and Red Cedar may be expected. A map of the reserve was made showing the various types of reproduction and areas where timber is wanting and can not be expected except by planting. This is an important feature of the investigation, since there are large tracts of this kind of land in the reserve. Full information in regard to planting and concerning suitable locations for nursery sites has been obtained.

A general reconnaissance was made of the timber belts of Oklahoma and surrounding regions for the purpose of finding whether they are extending since the settlement of the country. The opportunity which this investigation afforded to study the planted timber of the region was used. As a result of this investigation a report was submitted on forest extension and planting in Oklahoma.

#### REPRODUCTION OF THE WESTERN YELLOW PINE ON THE PRESCOTT FOREST RESERVE.

Because of the small amount of useful timber in central Arizona and the great need of lumber for the rapidly growing mining and agricultural interests a study of the reproduction of the Western Yellow Pine was made on the Prescott Forest Reserve. The purposes of this study, as of that made in Oklahoma, were to find (1) how far sufficient reproduction exists, (2) whether by artificial means this reproduction can be increased, and (3) whether planting is practicable on any portion of the reserve.

Reproduction surveys showed what portions of the reserve have now a sufficient stand of young timber, and some of the causes of the failure of reproduction were ascertained. Abundant evidence is present to show that the vital seed which reach the soil at a seasonable time have a high percentage of germination. Tests in seeding are advisable.

#### WHITE PINE REPRODUCTION IN NEW ENGLAND.

White Pine reproduces itself abundantly on abandoned fields and pastures in certain localities in southern New England, but the distribution of the young trees is not good. A study to discover methods of improving reproduction began in the summer of 1902 and continued far enough to indicate its practicability. The study was carried on locally in Worcester County, Mass., and Cheshire County, N. H. It showed that seed years for the White Pine in that region



take place with considerable regularity and that the seeding of a tract depends upon the proximity of seed-bearing trees, the condition of the surface soil, and the character of the ground cover. The latter two conditions being subject to easy control, there seems good ground for believing that methods may be found under which, if seed trees are present, the landowner may, without great difficulty, secure a fairly even stand of White Pine. The investigation, which is to be continued during the coming season, will make it possible to give definite recommendations to landowners who wish to improve the conditions for White Pine reproduction.

#### FOREST FIRES.

The object of the study of forest fires is to get the best information possible both on the immediate money loss by forest fires and on the indirect damage to the forest and to local interests of various kinds. The ultimate purpose is to find effectual methods of prevention and control.

#### OREGON AND WASHINGTON.

After the fires which occurred in Oregon and Washington in September, 1902, the Bureau at once made an investigation of the losses which had been sustained. The report of this investigation covered the loss of life and property, the causes of the fires, the methods used in fighting them, the damage to the soil, and the outlook for reproduction. The burned districts were mapped.

The area burned over in Oregon was approximately 170,000 acres, of which 120,000 acres carried a heavy stand of Red Fir, estimated at 17,700 board feet per acre, or 2,124,000,000 board feet. The value of this timber at a stumpage rate of \$1 per thousand, board measure, was \$2,124,000. Though much of this is a total loss, a great deal can still be utilized if lumbering is undertaken immediately. Logging roads have already been built into the burned districts.

The principal fires in Washington were in Skamania, Cowlitz, and Clarke counties, where the area burned is estimated at 434,000 acres. With the exception of 150,000 acres all of the land was fully as heavily timbered as in Oregon and of better quality. The amount destroyed is estimated at 5,026,800,000 feet board measure. At a stumpage value of \$1 per thousand the total stand of Red Fir amounted to \$5,026,800.

In addition to the green timber, both States sustained heavy losses in sawmills, sawed lumber, logs, railroad ties, telephone and telegraph poles, and cordwood, besides farm buildings, stock, hay and grain, fences, farming machinery, vehicles, and orchards. The total losses in Washington and Oregon are estimated to be as follows: Oregon, \$3,910,000; Washington, \$8,857,100—total both States, \$12,767,100.

Many of these fires could have been extinguished before they became serious. An efficient system of forest patrol in these localities would probably have prevented them altogether. Watchfulness on the part of the Government rangers prevented severe fires on the forest reserves.

#### GEORGIA AND FLORIDA.

An investigation was begun last March to determine the damage done by fires to forest reproduction in the Longleaf Pine forests of

northern Florida and southern Georgia. In this region, where the forest stand is never heavy and where grass always grows beneath the trees, it has been a long-standing practice to burn over the ground each year to improve the grazing. The investigation was attended by many difficulties, chief among which are that burning has been so general that areas not affected by fire could seldom be found, and without which there was no opportunity for comparison; that the individual fires are so light that the damage is not easily determined, nor is its influence long to be seen, and that the indifference of many of the people made it impossible to obtain specific information.

A few tracts of land were found, however, where, with the original condition the same throughout, some parts had been repeatedly burned, while others had been protected through a number of years. These conditions gave opportunity for a comparative study, the results of which are applicable over an extended region. This study, though at present incomplete, indicates that definite information may be secured on the damage which fire does to the Longleaf Pine forests.

#### THE LAKE STATES.

In May, 1903, investigations were begun in Michigan and Wisconsin to find methods of preventing forest fires in the White Pine region of the Lake States. In addition to a detailed study such as was conducted in the Southern States, the Bureau has made careful inquiry into the methods of fire protection proposed by railroads and land-owners. Fires do not occur so frequently in these regions as in the pine belts of the South, but more often reach the dimensions of a conflagration.

The Bureau of Forestry plans, by means of full field studies, to replace with carefully gathered facts the vague general notions that now exist about forest fires. After detailed study of particular regions the Bureau will be ready to recommend methods of fire protection and control for private land and, when called upon to do so, to suggest fire legislation for the various States.

#### RECLAMATION OF SHIFTING SANDS.

The protection of valuable property from the encroachment of shifting dunes and the reclamation of dune-covered land for economic uses have become important problems in some sections of the United States, particularly along the Atlantic and Pacific coasts, in the Great Lake district, and along the Columbia River in Washington and Oregon. The most effectual method of permanently reclaiming such land is to establish and permanently keep a forest upon it. European experience has abundantly shown that this can be done and that land which is not only useless but a source of grave danger will, when forested, yield returns.

For this reason the Bureau of Forestry has during the past year made examinations of some of the worst districts of shifting sand in the United States.

#### ATLANTIC COAST DUNES.

The dunes lying along the Atlantic coast between Cape Cod in Massachusetts and Cape Fear in North Carolina have received attention. The only extensive work yet done for the retention of sand in

this district is at the point of Cape Cod, where the State of Massachusetts owns a tract of several hundred acres known as the "Province Lands." Here at considerable expense the State has arrested the worst dunes by the planting of grasses. Grasses hold the sand temporarily, but it is only where trees have been used that the land may be said to be permanently reclaimed and to have attained practical value. The Bureau first considered most carefully the results of the work done on the Province Lands. This study assisted it in devising methods of reclamation in other places along the coast. As a result of this investigation it has begun to prepare tree-planting plans for owners of sandy areas along the coasts, under the general plan of cooperation in forest planting.

#### COLUMBIA RIVER DUNES.

Some of the most extensive and mobile sand dunes of the United States are to be found in the lower valley of the Columbia River, in Washington and Oregon. On the outer portion of the valley extensive farms and orchards have been developed on soil of great fertility, and between Pasco, Wash., and the Cascade Mountains the line of the Oregon Railroad and Navigation Company has been built. Both the railroad and the farming interests suffer great loss from the shifting sands. Bearing orchards have been completely engulfed, and valuable buildings have had to be moved because of it.

The sand of the Columbia River is much lighter than the sand of the Atlantic coast, on account of the quantity of mica which it contains. This makes it easily blown by the wind and also gives it great fertility when once fixed and supplied with water, so that with the reclamation of the sand dunes there are possibilities of profitable orchards and farm lands in connection with the belts of forest which will necessarily have to be established.

During the past year the Bureau has made a very careful investigation of the sand districts of the Columbia River. They have been mapped, and the trees which naturally thrive in sand in that region and which might be used were the work of reclamation begun have been closely studied. In addition a strip of land from 1 to 6 miles wide lying along the Columbia River, between Willow Creek and John Day River, has been withdrawn from settlement for experiment. This withdrawal contains some of the worst sand dunes of the entire river and will afford an opportunity for an extensive trial of the practicability of changing waste areas of this type into fertile agricultural land.

#### EXPENDITURES.

The expenditures in forest extension during the past year amounted to \$41,977.69, or 14.4 per cent of the total appropriation for the Bureau.

#### WORK FOR THE ENSUING YEAR.

The lines of work which have been laid down in the past will be continued and strengthened during the coming year. The addition of several field assistants to the force engaged in forest-extension work will easily make this possible.

Cooperative work in forest planting between the Bureau and land-owners is now firmly established and may be extended just so far as



the resources of the Bureau will permit. Not only will planting plans be made in increasing numbers, but more attention will be given also to the supervision of planting done under the plans and to the care of plantations after they are made.

The forest planting begun on two of the public reserves will be continued, and, if practicable, extended to several others during the next year. Work should be begun promptly on the Pikes Peak, Wichita, Prescott, and San Bernardino reserves.

Studies in the improvement of natural reproduction on the Pikes Peak Reserve and in northern New Mexico will be continued, as will also a study now in progress of the extension of the timber belts of western Kansas and an investigation of methods of restocking with forest the cut-over pine lands of southern Michigan. In southern New England the study begun last year on the improvement of the reproduction of White Pine is to be concluded. Other work in progress includes an investigation, in cooperation with the Forestry Association of Massachusetts, covering the problems of forest fires and reproduction and studies in cooperation with the State of California to determine methods of improving thin forest stands and to show the extent to which forest planting is practicable on mountain lands in that State. The growth and value for economic purposes of the planted Eucalypts in southern California will also continue as a part of this cooperative work. An investigation of methods of preventing and controlling forest fires under the same plan will soon be begun.

Special inquiries will be made into the causes of and damage from all serious forest fires which do not receive State investigation. The influence of fire on reproduction under the varying conditions prevailing in different forest regions will continue to receive attention.

The reclamation of shifting sand by forest growth will be vigorously prosecuted on the Atlantic coast, in the Lake region, and on the Columbia River. On private lands the Bureau will cooperate with landowners. On Government land the Bureau will itself begin work in a limited number of places.

## FOREST PRODUCTS.

### TIMBER TESTS.

An investigation of the mechanical properties of timber was undertaken by this Bureau on September 1, 1902, in cooperation with the road-material laboratory of the Bureau of Chemistry. Its specific purpose is to determine the strength and durability of the merchantable timbers of the United States. In planning the work the effort has been to confine it to the solution of practical problems and to avoid those of purely scientific interest. A circular was prepared and printed stating in detail the methods to be employed and the results expected. This was sent to prominent engineers, manufacturers, and lumbermen, with a request for candid criticism and suggestion. The replies show a keen appreciation of the importance of the work and in almost every case approve the plan outlined in the circular. The intention of the Bureau to test actual commercial products in the form of full-sized sticks of structural timber received the commendation not only of practicing engineers but of eminent authorities on testing, such as Prof. G. Lanza, to whom the principal features of the plan were due.

The scope and purpose of the timber tests may be briefly summarized as follows:

*SERIES A.—Tests of the mechanical and physical properties of timber as found on the market:* Actual sizes and grades of commercial products will be used. The purpose is to determine moduli for design; to ascertain the value of woods now considered inferior; to determine the liability to knots and their reducing effect on the strength of timbers; to arrange a table of standard weights and rules of inspection and grading, and to compare the properties of the same species from different regions.

*Tests to determine the effects of variations in the testing process:*

*SERIES B—*Effect of rate of application of load, including impact tests.

*SERIES C—*Effect of moisture.

*Studies of the effect and efficiency of technological processes:*

*SERIES D—*Preservatives.

*SERIES E—*Methods of seasoning.

*SERIES F—*Fire retardants.

*SERIES G—*Effect of forest conditions.

The Bureau of Forestry is now conducting timber tests at three laboratories. The Washington laboratory, in addition to the execution of tests assigned to it, has general supervision over the other laboratories and the direction of their work. These are the laboratories at New Haven, in which the Bureau is cooperating in timber tests with the Yale Forest School, and the laboratory at Berkeley, in which similar cooperation is going on with the University of California.

The tests at present being made under Series A include tests of the Pacific Coast Red Fir and Hemlock, of Longleaf Pine, and of second-growth Loblolly Pine. An investigation of the mechanical properties of the Southern gums is planned for the immediate future. Series B and C are under way. Efforts are now being made to secure the cooperation of those interested in outlining a scheme for investigation under Series D. Work upon Series F and G has not yet begun.

Testing Longleaf Pine beams, measuring 12 by 16 inches, was the first work undertaken at the Washington laboratory. Thirteen full-sized beams were broken, and many small pieces taken from them were subjected to minor tests, such as those for resistance to compression and shearing. The testing was done in accordance with the standard practice; but new features were the photographing of all four sides and the two ends of each beam, and the recording of its actual market grade. After the series of tests is complete these additional records will be valuable in determining the reason for unusual strength or weakness. The tests of market timber will also serve to check the values obtained by the Division of Forestry in former tests of material, which were not conducted as described. During the year the results of the work upon Longleaf Pine were tabulated, and experiments were conducted to determine the moisture in the beams tested at Berkeley and New Haven. Tests upon second-growth Loblolly Pine were begun.

The work of the laboratory at New Haven, in cooperative work begun in September, 1902, comprised the testing of 14 Longleaf Pine beams, together with numerous minor tests of smaller specimens cut from them. The work of this laboratory for the immediate future will consist in an investigation to determine the best methods for making timber tests and the effect on the results of tests of such factors as speed of application of load and the amount of moisture and of volatile oils in the timber tested. The laboratory is equipped

with a 150,000-pound Riehle testing machine and with the other apparatus necessary for thorough work.

At the Berkeley laboratory work in cooperation with the University of California began in April, 1903. The work during the year included the testing of 56 Red Fir beams, the first step in a series of investigations of Pacific coast timbers. The investigation has the enthusiastic support of lumbermen, engineers, and manufacturers. Two carloads of timber have been given to the laboratory as testing material, and many times that amount has been promised when needed. The timber is given free transportation by the railroads.

#### WOOD PRESERVATION.

The purpose of the work of the Bureau in wood preservation is to determine the best methods for the seasoning of construction, railroad, and other timbers, and for increasing their durability by the use of preservative processes. Particular attention is given to ascertaining methods of treatment by which the employment of inferior woods may be rendered profitable, and economy in the use of woods of more valuable kinds may thus be increased. The work has received throughout the enthusiastic support of the railroad companies. They have furnished free transportation to the agents of the Bureau; have provided material for experiment, and scales and other appliances; have transported material for treatment from place to place free of charge, and in other ways have rendered notable assistance in the work.

Studies to determine the best methods of seasoning Lodgepole Pine railroad ties and the time required to season ties cut in different months have been carried on at Bozeman, Mont. One hundred ties were weighed each month, immediately after they were cut, and then piled in variously constructed open piles to determine the best form for thorough and rapid seasoning. The ties were weighed again at the end of fifteen days, and at intervals of thirty days thereafter until thoroughly air dry. After the seasoning was completed the ties were shipped to Sheridan, Wyo., for treatment by different preservative processes. It was demonstrated that by proper seasoning before shipment the ties lose nearly 40 per cent in weight. It was also shown that when the timber was properly seasoned about one-third less time was required for treating it. All ties were marked with record nails showing the months in which they were cut and the treatment given them, and then placed in the track in order that their durability might be tested by actual trial.

Similar investigations are being made of railroad ties manufactured from the inferior oaks, the gums, and the beech of eastern Tennessee, Kentucky, Arkansas, and Mississippi. When seasoned these ties will be treated with preservatives and placed in service. More thorough seasoning in much shorter time has already been attained by improved methods of piling.

A study of Loblolly and Shortleaf railroad ties is being made in eastern Texas. About 2,000 ties have been cut each month under the supervision of an agent of the Bureau. These ties were taken from different localities and from different parts of the tree. They are so marked that a record can be made of the differences they show in water content, weight, strength, durability, and absorption of preservatives. A tie yard has been provided by the railroad company,



to which the ties are hauled and where they are weighed and piled in order to determine what form of pile will give the best results. The weights are recorded, and the ties are re-weighed at intervals of thirty days until air dry. From these tests accurate data will be obtained as to the time required to season Loblolly and Shortleaf Pine ties cut in any month of the year.

In cooperation with the American Telephone and Telegraph Company, the best methods for seasoning Chestnut telegraph and telephone poles are being thoroughly investigated. Fifty poles are cut each month, and under the supervision of an agent of the Bureau of Forestry are weighed and piled on skids to season. The poles are then weighed at intervals of thirty days to determine the rate of seasoning. Each pole is marked with a dating nail designating the month in which it was cut. When the poles are thoroughly air dry they are placed in position by the company, each pole being marked with nails indicating the date of cutting and the date the pole was put in use. Since in common practice the green poles are placed directly in the ground, it is expected that considerable increase in the length of life of the poles will result from the seasoning. In December an experimental line of poles was put in place by the company under the direction of an agent of the Bureau. The butts of 100 poles were treated and the poles set up in cement and broken rock in order to determine the effect of the surrounding medium upon the durability of the poles. Untreated poles were similarly placed for the purpose of comparison.

In southeastern Texas an exhaustive study is being made of the various methods of tie treatment in order to determine which is the most profitable for that region. Two years ago 8,000 ties were placed in the track of the Gulf, Colorado and Santa Fe Railway. These ties are of 13 different kinds of wood. They are impregnated by 12 separate processes in order to test the relative durability of each wood under each preservative treatment. A certain number of ties of each kind were put in the track without treatment. All ties are marked with record nails indicating the kind of wood, the treatment which the tie has received, and the date when it was placed in the track. These ties are examined every two months by agents of the Bureau. It has been noted that all of the untreated ties are already affected by decay. After another year this experiment will furnish, for the region in which it is made, reliable data for the length of life of ties of different kinds, both when untreated and when treated under different processes.

#### STUDY OF PROPOSED RESERVES.

This work, which includes studies of the boundaries of existing National forest reserves and of proposed forest reserves as a basis for recommendations, has been undertaken under the request of the Secretary of the Interior upon the Secretary of Agriculture for advice upon technical questions involved in the administration of the reserves.

In the summer of 1902 examinations and reports were made of the following proposed reserves and proposed additions to existing reserves:

*Utah:* Aquarius, Logan, Manti, Sevier, Salt Lake, Gunnison, and Beaver Forest reserves.

*California:* Stony Creek, and additions to the San Jacinto, Lake Tahoe, San Gabriel, Pine Mountain and Zaca Lake Forest reserves.

*Oregon:* Blue Mountain, and addition to the Cascade Range Forest Reserve.

*New Mexico:* Addition to the Gila River Forest Reserve.

Of these the Logan, Aquarius, and Manti reserves have been created.

Beginning with May, 1903, agents of the Bureau were in the field for examination and report on proposed forest reserves in New Mexico, Arizona, Utah, Colorado, Idaho, Washington, Oregon, and California. It is intended to examine over 20,000,000 acres during the field season. Twenty-nine men were engaged in the field work.

#### EXPENDITURES.

The expenditures in forest products during the past year amounted to \$12,098.07, or 14.4 per cent of the total appropriation for the Bureau.

#### WORK FOR THE ENSUING YEAR.

##### TIMBER TESTS.

A station for timber testing has been established at Lafayette, Ind., in cooperation with Purdue University, and work will begin in September. The first problem to be attacked will be a determination of the mechanical properties of Red Oak, White Oak, Hickory, and Red Gum. At the urgent request of manufacturers the question of the best sizes and kinds of timber for box boards will be thoroughly investigated. The Washington laboratory will continue the work begun upon Long-leaf and second-growth Loblolly pines. The New Haven laboratory will be occupied in a determination of the effect of moisture and volatile oils on the mechanical properties of timber. The effect of speed of loading upon the results obtained from timber tests will also be investigated. At the Berkeley laboratory tests of Red Fir will be continued and tests of Western Hemlock and Redwood will be taken up.

##### WOOD PRESERVATION.

During the coming year studies already begun to determine the best methods for the seasoning and treating of timber by preservative processes will be continued. An exhaustive experiment will be made to determine the suitability after preservative treatment of Adirondack hardwoods for use as railroad ties.

##### STUDY OF PROPOSED RESERVES.

The study of proposed reserves and of the boundaries of existing reserves, which is now the most urgent piece of work before the Bureau, will be pushed as rapidly as its resources in men and money permit.

#### RECORDS.

##### FOREST LIBRARY.

The usefulness of the forest library has grown steadily. During the year 664 books and pamphlets were added. The book catalogue was completed and now contains references to all books in the library of the Bureau of Forestry, to forest periodicals and serial publications in the Library of the Department, and to technical and other works of interest to foresters in the Library of the Department and in the

Library of Congress. Newspaper clippings to the number of 1,947 were added and classified. Articles of interest in the lumber trade journals and forest periodicals were indexed.

The collection of photographs now numbers 9,476. Of the 3,417 photographs added during the year, 3,052 are views taken in 41 States and Territories, while 365 were received from foreign countries. These include collections from Australia, Austria, and Denmark and valuable additions to the collections from Germany, India, and Switzerland.

The collection of lantern slides, which was increased during the year by 782, has been greatly improved by the coloring of slides. Loans of 908 slides to assist in lectures on forestry were made to 28 persons during the year.

#### CORRESPONDENCE.

The correspondence of the Bureau continued to increase greatly and exceeded that of the previous year by 75 per cent. There were forwarded from the Bureau during the year 43,700 pieces of mail matter.

#### MAILING LISTS.

The mailing lists of the Bureau are the following: (1) A special list of libraries; (2) a list of representative newspapers; (3) a small foreign list of scientific and governmental institutions; (4) a special list of persons engaged in forestry work in the United States; (5) a general list of persons interested in forestry.

The first four lists, which number 3,008 addresses, receive all publications of the Bureau as soon as they are available. To the general list are sent the reports of the Forester, reprints of the contributions from the Bureau of Forestry to the Yearbook of the Department, and circulars of information. Cards are also sent giving notice of the appearance of bulletins, with brief descriptions of their contents. Applications for bulletins made in response to the card notices are honored in the order of their receipt. The number of addresses on the general list at the end of the year was 8,778.

#### PUBLICATIONS.

During the year 18 new publications appeared, of which 237,000 copies were printed. The bulletins were as follows: The Western Hemlock; A History of the Lumber Industry in the State of New York; Eucalypts Cultivated in the United States; The Woodsman's Handbook, Part I; The Hardy Catalpa; The Redwood; Conservative Lumbering at Sewanee, Tennessee; A New Method of Turpentine Orchardling; Seasoning of Timber; and The Woodlot. The two circulars were: A New Method of Turpentine Orchardling; and Forestry and the Lumber Supply. Five reprints of Yearbook articles were issued, as follows: Grazing in the Forest Reserves; A Working Plan for Southern Hardwoods and its Results; Practicability of Forest Planting in the United States; Influence of Forestry upon the Lumber Industry; and Tests on the Physical Properties of Timber. There was also published the Report of the Forester for 1902.

In addition to these publications 23 press bulletins were issued during the year, with a total circulation of 113,200 copies.



Reprints of 14 publications were made to the total number of 76,500 copies.

On July 1, 1903, 6 bulletins, including Part II of A Primer of Forestry, were in the hands of the printer.

#### PHOTOGRAPHIC LABORATORY.

Since the beginning of the fiscal year the photographic laboratory has been fully equipped for work in all branches of photography. With these improved facilities it was possible, with the same personnel as last year, to accomplish 25 per cent more work. The number of films and plates developed was 6,563; prints and copies made, 15,473; mounts, 4,747; lantern slides, 746, and blueprints, 167—a total of 27,696 items of work performed during the year.

#### INSTRUMENTS.

The large increase in the field work of the Bureau made necessary the purchase of many additional instruments. The expenditure for instruments and field equipment during the fiscal year was \$7,170.16, or 2½ per cent of the total appropriation.

#### SUPPLIES.

Strict economy has been observed in the purchase of supplies, which were paid for entirely from the funds of the Bureau of Forestry. No supplies of any kind were furnished from the contingent fund of the Department. The expenditure for supplies was \$9,752.59, or 3½ per cent of the total appropriation.

#### ACCOUNTS.

The system of accounts introduced in the Bureau of Forestry at the beginning of the fiscal year 1902 has continued in operation, with extremely satisfactory results.

#### DRAFTING.

With the rapid extension of the field work of the Bureau the demands for drafting increased considerably and the employment of two additional draftsmen became necessary. The work consisted of making maps for working plans and planting plans; illustrations, diagrams, and tables for bulletins of the Bureau; maps of forest reserves; maps of regions investigated; and entering silvicultural data upon maps. A record of all forest reserves, with their boundaries and descriptions, was kept posted, as heretofore.

#### EXPENDITURES.

The expenditures during the past year in records, which includes printing, instruments, supplies, and rent, amounted to \$90,264.55, or 30.9 per cent of the total appropriation for the Bureau.

The expenditures for Bureau supervision and control in salaries and traveling expenses amounted to \$18,613.21, or 6.4 per cent of the total appropriation for the Bureau.



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